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TRAINING THE VOICE BY THE AID OF THE EYE IN SINGING.

C. E. SEASHORE AND E. A. JENNER,

University of Iowa.

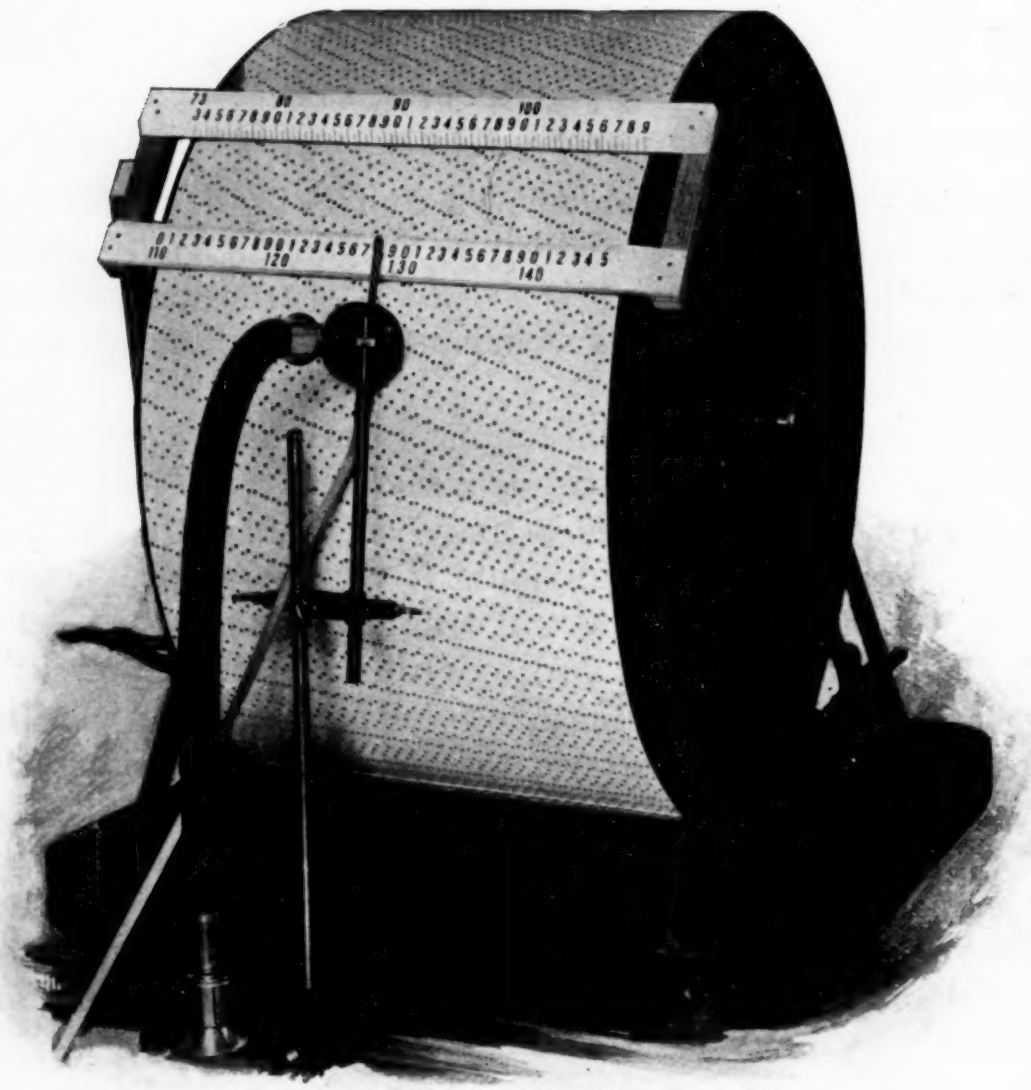
Can we facilitate development of control in the pitch of the voice by using an aid to the ear in training? And, may the ordinary limits of accuracy be exceeded by training with such an aid? The following experiments answer these questions quantitatively.

The limit of accuracy in singing is ordinarily set by the physiological limit of the ear, as measured by the least sensible difference in pitch. This limit varies in different individuals, but in a given individual it remains approximately constant in health, regardless of training. It is not probable that this limit is ever reached by ordinary methods of training, but if we have some means of doing for the ear what the microscope does for the eye, the time of approaching this limit by training may be shortened and the effectiveness of the ear may be increased. In other words, the singer may develop accuracy in pitch more rapidly and may reach a higher degree of refinement in his control of the pitch of the voice than could have been reached without the use of some such aid.

We used the voice tonoscope of the design shown in the accompanying figure.[1] The instrument works on the principle of the stroboscope, more familiarly known as the principle of moving pictures. It converts the sound vibrations

[1] For a full description of the instrument here used, see SEASHORE *"The Voice Tonoscope,"* University of Iowa Studies in Psychology, 1902, III., 18-28. Since then the instrument has been rebuilt with many improvements. A description of the new model will appear in the same Studies, Volume VI.

into visual configurations which point out on a large, clear scale the actual vibration frequency of any tone that is sung before it. The reading is direct in terms of a vibration or a fraction of a vibration, and is accurate beyond the degree here



THE TONOSCOPE.

required. The singer sings before the speaking tube, which is connected with a sensitive flame capsule in such a way that every vibration of the column of air in the tube causes a vibration in the flame, and this vibrating flame selects from the series of dots those which correspond to the vibration

frequency of the tone. The operation of the instrument is such that the singer may, without restraint, sing within his own range.

The tests may be divided into (A) accuracy in striking a required pitch, and (B) the least producible change in pitch (minimal change). The former may be subdivided into (a) sounding a standard tone heard, and (b) striking an interval from that standard. The three intervals used were (1) the major third, (2) the fifth, and (3) the octave. The standard or fundamental tone was 100 vd.; the intervals were, therefore, 125 vd., 150 vd., and 200 vd., respectively. The least producible change was determined for each of these four tones (1) in the least producible sharp and (2) in the least producible flat from the note as actually struck.

The observer was given a preliminary practice both with and without the instrument. This was quite extensive, the object being to make sure that he was thoroughly familiar with the method and conditions of the experiment, so that the adaptation should not enter as a disturbing element in the first series. We worked with six observers, none of them professional singers, but such as could be considered good material for amateur singing.

The standard tone, heard in the telephone from a 100 vd. tuning fork, was a good, clear tone of agreeable intensity, and was sounded during one second for each trial. The singer was encouraged to sing the response about one second after hearing the standard, to sustain the tone about one second, and to make the interval between two tones sung in the minimal change series about one second.

Each period of practice consisted of one hundred and sixty trials, which took about forty-five minutes. The tests continued twelve days, approximately successive, and were divided as follows: The first five days the singer had no aid but depended entirely on the ear as in ordinary singing ("without aid"); then followed five days of singing with aid, that is, the record was read from the tonoscope in each trial, giving the observer an opportunity to correct himself

in the next trial ("with aid"); then the record of the eleventh day was taken without aid again, and the record of the twelfth day was taken with the aid. Thus, we obtained during the first five days a measure of the ability without the aid; the second five days, the ability with the aid, the measurements of the eleventh and twelfth days will show whether or not training gained by means of the aid is transferred to singing without the aid.

The results of these experiments on six men are shown in the following tables and curves. The numerals at the head designate the successive days of practice, and the initials at the left represent the observers. Each number in the body of the table represents the average error in pitch of twenty trials for the designated observer, day and case, in terms of vibrations. For the best singer the records were read in tenths of a vibration; but for the others only in whole vibrations, as the steadiness of the voice did not warrant any finer reading. In Tables V. to VIII., the column headed "%C" shows in what per cent. of cases the observer actually succeeded in making the sharp or flat. This is introduced merely to show the relative risk that the observer took of not making any change at all. These tables are made up from the mean of the sharp record and the flat record. The average record for the six observers is expressed in the curves. The numbers of the curves correspond to the numbers of the tables. All heavy horizontal lines represent the averages of the daily averages which are shown in the light curves. The appendages at the right show the averages for the eleventh and twelfth days, respectively. The zero point is below in every curve, hence a low point in the curve denotes relative superiority and a high point relative inferiority in the record.

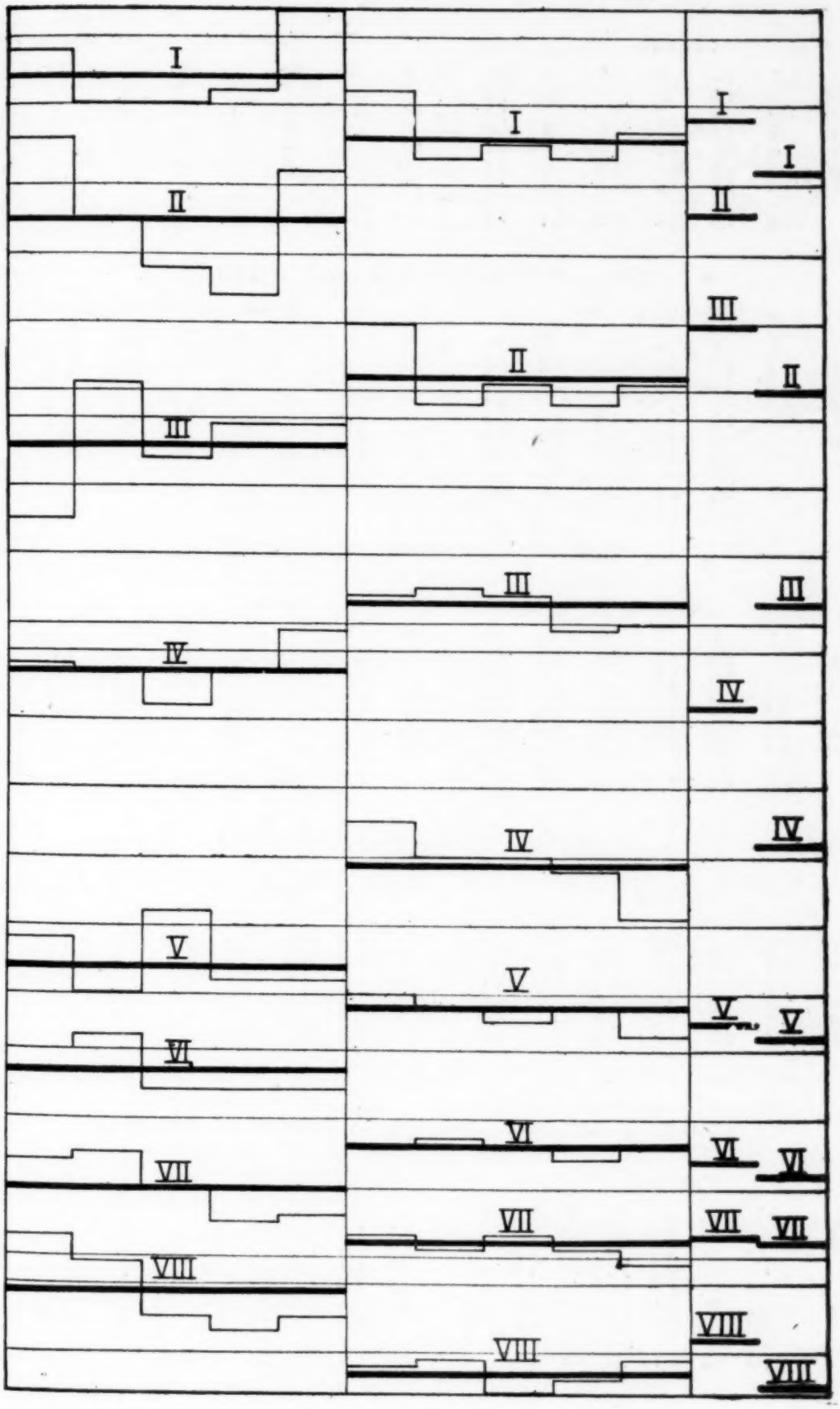

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TABLE I. SINGING THE FUNDAMENTAL.

	Unaided.						Aided.						Unaided.	Aided.
	1	2	3	4	5	Ave.	6	7	8	9	10	Ave.	11	12
G. M.	.8	1.0	.4	.8	3.3	**1.4**	.5	.6	.7	.4	.9	**.6**	...	...
P. N.	3.4	.5	.7	1.1	1.3	**1.3**	1.0	.4	.6	.7	1.1	**.6**	.9	.7
D. S.	.7	1.4	1.1	.6	1.2	**1.0**	.5	.2	.5	.6	.4	**.4**	1.3	.3
G. S.	1.3	1.4	1.4	.7	.8	**1.1**	1.1	.6	.3	.6	1.1	**.7**	.5	.5
M. W.	1.1	.8	1.0	1.8	.9	**1.1**	.9	.7	.6	.9	.9	**.8**	1.4	.7
E. G.	1.4	1.0	1.2	1.5	2.5	**1.5**	2.8	1.1	1.5	.5	.6	**1.3**	.5	.5
Ave.	**1.4**	**1.0**	**1.0**	**1.1**	**1.7**	**1.2**	**1.1**	**.6**	**.7**	**.6**	**.8**	**.7**	**.9**	**.5**

TABLE II. SINGING THE MAJOR THIRD.

	Unaided.						Aided.						Unaided.	Aided.
	1	2	3	4	5	Ave.	6	7	8	9	10	Ave.	11	12
G. M.	2.4	1.5	1.3	1.1	2.9	**1.8**	.9	.8	.7	.8	.7	**.7**	...	...
P. N.	8.4	5.6	1.0	2.5	2.1	**3.8**	1.4	1.0	1.0	.7	.9	**1.1**	1.9	1.0
D. S.	1.5	2.1	2.8	.6	3.3	**2.1**	1.0	.8	.6	.9	.8	**.8**	5.2	.8
C. S.	1.1	1.5	3.4	2.2	1.0	**1.8**	2.2	1.0	1.5	1.2	2.0	**1.6**	2.2	.8
M. W.	5.3	3.3	1.6	3.7	4.5	**3.7**	1.5	.8	1.1	1.2	1.7	**1.3**	3.3	1.2
E. G.	4.3	2.4	4.2	2.5	5.4	**3.8**	4.5	2.5	3.2	2.1	1.8	**2.8**	1.7	2.1
Ave.	**3.8**	**2.7**	**2.4**	**2.1**	**3.2**	**2.8**	**1.9**	**1.1**	**1.3**	**1.1**	**1.3**	**1.4**	**2.9**	**1.2**

TABLE III. SINGING THE FIFTH.

	Unaided.						Aided.						Unaided.	Aided.
	1	2	3	4	5	Ave.	6	7	8	9	10	Ave.	11	12
G. M.	1.5	2.4	3.5	6.1	2.1	**3.1**	1.3	2.2	1.7	2.5	1.2	**1.8**	...	...
P. N.	2.4	9.3	2.5	3.4	4.2	**4.0**	1.6	2.9	1.6	.5	3.2	**2.0**	7.3	1.4
D. S.	3.4	6.2	6.7	3.1	5.8	**5.0**	1.4	1.5	1.1	1.1	1.3	**1.3**	5.3	2.2
C. S.	2.1	1.1	1.7	3.3	.8	**1.8**	1.5	.9	1.5	1.4	.9	**1.2**	4.5	2.2
M. W.	4.4	4.6	2.6	3.8	4.3	**3.8**	1.6	1.7	1.7	2.2	2.1	**1.8**	4.5	1.6
E. G.	1.8	1.0	2.4	2.4	2.8	**2.1**	3.0	2.3	3.1	.7	.5	**1.9**	2.4	1.4
Ave.	**2.6**	**4.1**	**3.3**	**3.7**	**3.7**	**3.5**	**1.8**	**1.9**	**1.8**	**1.4**	**1.5**	**1.7**	**4.8**	**1.7**

TABLE IV. SINGING THE OCTAVE.

	Unaided.						Aided.						Unaided.	Aided.
	1	2	3	4	5	Ave.	6	7	8	9	10	Ave.	11	12
G. M.	2.8	5.6	2.6	2.1	7.0	**3.9**	1.7	2.2	1.8	2.3	1.4	**1.9**	...	...
P. N.	5.9	2.2	1.9	2.5	5.9	**3.7**	.5	2.7	1.4	1.4	1.0	**1.4**	2.3	1.1
D. S.	4.1	10.6	13.0	11.5	6.3	**9.1**	2.5	1.5	1.2	1.4	1.9	**1.7**	6.0	1.4
C. S.	1.5	2.5	2.3	3.2	1.6	**2.2**	1.8	.7	1.0	2.0	.3	**1.2**	4.5	2.5
M. W.	8.2	4.9	2.8	4.9	5.5	**5.3**	1.4	1.0	1.8	2.0	1.4	**1.5**	5.5	2.5
E. G.	6.1	2.1	2.5	3.9	5.6	**4.0**	7.2	4.0	5.0	1.8	.7	**3.7**	2.9	3.3
Ave.	**4.8**	**4.7**	**4.2**	**4.7**	**5.3**	**4.7**	**2.5**	**2.0**	**2.0**	**1.8**	**1.1**	**1.9**	**4.2**	**2.2**

TABLE V. MINIMAL CHANGE ON THE FUNDAMENTAL.

	Unaided.							Aided.							Unaided.	Aided.
	1	2	3	4	5	Ave.	%C	6	7	8	9	10	Ave.	%C	11	12
G. M.	1.8	1.4	2.1	1.9	1.8	**1.8**	96	1.5	1.4	1.4	1.2	1.2	1.3	98	...	...
P. N.	2.2	2.1	4.5	2.4	2.8	**2.8**	97	2.2	1.9	1.8	1.9	1.2	**1.8**	93	1.4	1.4
D. S.	1.5	1.3	1.9	1.7	1.5	**1.6**	98	1.1	1.0	1.0	1.3	1.2	**1.1**	92	1.0	1.0
C. S.	1.0	1.2	1.1	1.0	1.0	**1.1**	96	1.0	1.1	1.1	1.1	.9	**1.0**	95	1.0	1.0
M. W.	2.1	1.6	1.5	1.4	1.7	**1.7**	96	1.8	1.6	1.6	1.4	1.4	**1.6**	96	1.7	1.3
E. G.	2.7	1.5	1.4	1.2	1.1	**1.6**	74	1.5	1.4	1.1	1.4	1.2	**1.3**	88	1.3	1.1
Ave.	**1.9**	**1.5**	**2.1**	**1.6**	**1.6**	**1.7**		**1.5**	**1.4**	**1.3**	**1.4**	**1.2**	**1.4**	..	**1.3**	**1.2**

TABLE VI. MINIMAL CHANGE ON THE MAJOR THIRD.

	Unaided.							Aided.							Unaided.	Aided.
	1	2	3	4	5	Ave.	%C	6	7	8	9	10	Ave.	%C	11	12
G. M.	3.5	5.0	4.5	3.8	3.4	**4.0**	96	3.2	2.2	2.2	2.0	2.0	**2.3**	96	...	...
P. N.	3.1	5.2	5.0	3.5	3.7	**4.1**	99	2.7	2.1	3.5	3.1	2.0	**2.7**	97	2.2	2.3
D. S.	2.5	2.8	2.9	2.5	2.1	**2.6**	96	1.8	2.0	1.6	2.0	2.4	**2.0**	91	2.5	2.0
C. S.	2.3	2.1	1.9	1.8	2.0	**2.0**	90	1.9	1.9	1.9	1.9	2.1	**1.9**	93	2.3	1.7
M. W.	3.8	2.7	2.1	2.2	2.8	**2.7**	94	2.4	2.9	2.9	2.8	2.5	**2.7**	96	2.9	2.6
E. G.	5.3	5.2	1.8	2.0	2.5	**2.9**	64	3.1	2.5	2.8	1.9	2.3	**2.5**	83	2.5	2.4
Ave.	**3.4**	**3.5**	**3.0**	**2.6**	**2.7**	**3.0**		**2.5**	**2.3**	**2.5**	**2.3**	**2.3**	**2.4**	..	**2.5**	**2.4**

TABLE VII. MINIMAL CHANGE ON THE FIFTH.

	Unaided.							Aided.							Unaided.	Aided.
	1	2	3	4	5	Ave.	%C	6	7	8	9	10	Ave.	%C	11	12
G. M.	1.9	3.4	2.5	2.5	2.5	**2.6**	99	1.4	1.3	1.3	1.1	1.6	**1.3**	97	...	...
P. N.	2.8	4.2	3.3	2.7	3.1	**3.2**	99	2.1	1.6	1.5	1.1	1.3	**1.6**	98	1.5	1.4
D. S.	1.4	2.3	2.5	2.1	2.1	**2.1**	100	1.1	1.2	1.5	1.3	1.1	**1.2**	98	1.3	1.2
C. S.	1.2	1.3	1.4	1.5	1.2	**1.3**	96	1.5	1.4	1.2	1.0	1.2	**1.3**	98	1.3	1.2
M. W.	3.4	2.4	1.7	2.6	2.2	**2.5**	97	2.1	2.1	2.4	2.5	2.4	**2.3**	100	2.4	2.2
E. G.	4.4	1.8	1.5	1.1	1.4	**2.0**	65	2.2	1.8	1.8	1.4	2.1	**1.9**	92	1.4	1.4
Ave.	**2.5**	**2.6**	**2.1**	**2.1**	**2.1**	**2.3**		**1.6**	**1.7**	**1.6**	**1.5**	**1.6**	**1.6**	..	**1.5**	**1.4**

TABLE VIII. MINIMAL CHANGE ON THE OCTAVE.

	Unaided.							Aided.							Unaided.	Aided.
	1	2	3	4	5	Ave.	%C	6	7	8	9	10	Ave.	%C	11	12
G. M.	4.9	5.7	4.8	4.1	5.0	**4.9**	95	2.5	2.8	2.5	2.7	2.3	**2.6**	96	...	...
P. N.	4.9	5.7	4.7	4.8	5.2	**5.1**	100	3.2	3.8	2.5	3.2	2.3	**3.0**	94	3.4	2.5
D. S.	3.7	5.5	4.4	3.9	3.7	**4.2**	91	2.4	3.1	2.5	2.5	3.7	**2.8**	89	2.7	3.0
C. S.	2.8	1.7	2.7	2.0	2.7	**2.4**	88	2.4	2.1	1.9	1.9	2.2	**2.1**	95	2.4	2.9
M. W.	4.6	3.2	2.4	2.8	2.5	**3.1**	89	3.8	3.0	3.0	3.0	3.9	**3.3**	97	3.5	2.5
E. G.	7.0	3.8	2.3	2.2	2.2	**3.5**	71	2.8	2.5	2.4	2.7	2.9	**2.7**	75	3.2	2.5
Ave.	**4.7**	**4.3**	**3.5**	**3.3**	**3.5**	**3.9**		**2.8**	**2.9**	**2.4**	**2.6**	**2.9**	**2.7**	..	**3.2**	**2.5**

In a preliminary experiment of this sort, we face a difficulty in the attempt to eliminate the element of progressive gain from the comparison of the two series, the aided and the unaided. As the curves show, the records vary from day to day, so that it is necessary to have several days in a series in order to obtain a fair average. Then, in order to obtain a measure of the natural ability in the unaided series, it is necessary to take that before the aided. Of course the thing to do in the future is to take a much longer series. But in view of the fact that the records for the second series fall on distinctly different levels, and that the evidence of progressive gain within a series is not pronounced, we may neglect this factor of progressive gain for the present purpose, provided we draw no finer distinctions in our conclusions than this neglect would permit. In the following con-

densed statements of conclusions, reference is made merely to the averages. The reader can readily trace the individual peculiarities in the tables. The necessary brevity of this article prevents us from discussing each item in detail, both as to method of procedure and results. Except where otherwise specified, unaided refers to the first five days, and aided to the second five days.

1. The aid enhances the ability to strike a tone which has been heard. See Table I and Figure I. The superiority of the aided series over the unaided amounts to 42%.

2. The aid enhances the ability to sing an interval. See Tables II, III and IV, and the corresponding curves. The superiority of the aided series over the unaided amounts to 50% for the major third, 50% for the fifth, and 60% for the octave.

This involves two factors; namely (a) ability to strike the tone heard or imaged, as in I, and (b) the efficiency of the memory image of the interval. If we assume that the difficulty of striking an imaged interval represents the same degree of difficulty, as the striking of the fundamental tone, we may get a measure of the gain in the accuracy of the memory image by substracting the 42% gain, Table I, from the gross gain from the respective intervals, namely, 50%, 50%, and 60%, which leaves a gain of 8 % for the major third, 8% for the fifth, and 18% for the octave, to be attributed to a correction of the image of the interval.

3. The voluntary control of the pitch of the voice is improved by the aid. See Tables V, VI, VII and VIII and the corresponding curves. The average superiority of the aided series over the unaided for all intervals amounts to 26%.

4. There is probably some transfer of gain from the aided training to following unaided singing. Compare records for the unaided series with those of the eleventh and twelfth days, Table I and Figure I. This is, of course, a most vital point. If the gain were not transferred to singing without aid, it would lose its principal value.

5. There is no evidence of transfer of the gain in the accuracy of the memory image. See Tables II, III, and IV and the corresponding curves. This is undoubtedly due to the fact that we have here to do with memory rather than discrimination and the acquisition of accurate memory images is a slow process—too slow to show in this short series.

6. The gain in the discriminative control of pitch of the voice is fully transferred. See Tables V, VI, VII and VIII and the corresponding curves.

7. Improvements in the ability to strike a tone, or an interval, and the ability to produce a minimal change, are very much more pronounced and more rapid in the aided than in the unaided series. See all the curves.

These seven points answer the first question which we asked at the outset: by the use of the tonoscope we facilitate in a decided manner the ability to sing in true pitch and the improvement is almost immediate.

8. The second question is not answered absolutely by our records, but it seems probable (1) from the radical and immediate improvement of the aided series over the unaided, and (2) from the introspection showing that a tone which without the instrument seemed entirely satisfactory to the ear could be corrected by the ear after the error had been pointed out by the instrument, that a higher degree of accuracy of pitch in singing may be attained by aiding the ear in the training than would be possible to attain without such aid. No matter how keen the ear of a trained musician, it can be shown in a single test that his ear has been "too generous"—too easily satisfied, for when the error is pointed out objectively he can recognize it. We thus find accumulative evidence to show that the singer cannot reach the physiological limit of occuracy by the ordinary methods of vocal culture, because he has no objective criterion by which he can check up the accuracy of the ear.

9. The major third, the fifth, and the octave are approximately equally difficult intervals to sing. If we express the

average error in relative fractions of a tone (1/25 of a tone) instead of in vibrations, the ratio is 1.4, 1.5, and 1.4, for the three intervals as named above. The average error expressed in terms of vibrations, as in the tables, shows that the difficulty of a natural interval varies approximately with the magnitude of the interval.

10. The minimal change is a relatively constant fraction of a tone within this octave. This is true for both the aided and the unaided series. If we reduce the records in Tables V-VIII from vibrations to twenty-fifths of a tone, the minimal change is 3.1, 3.1, 3.6, 3.3, for the fundamental, the major third, the fifth and the octave respectively. This is surprising, because within this part of the tonal range the pitch discrimination is normally measured by a constant vibration frequency instead of by constant part of a tone. Experiments are in progress to verify this finding for singing over a larger tonal range.

11. Our experiments have demonstrated that we have, in the methods and instruments here used, very satisfactory means of measuring accuracy of singing without waste of time and without hampering the singer. A vast field for psychological and musical experimentation is hereby opened up. The facts outlined above have not only a theoretical interest but a practical value.[1] What will the music conservatory say about it? The situation is unique. The pedagogical principle involved is radically new in music. The instrument is a fundamentally new conception. It involves an expense to the vocal studio.

[1] For a discussion of the use of the tonoscope in the conservatory of music, see *"The Musician,"* Volume 51, July, 1906.

AN EXPERIMENT ON METHODS OF TEACHING ZOOLOGY.

(PRELIMINARY REPORT.)

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From the Laboratory of the School of Education, University of Illinois.
Communicated by Professor W. C. BAGLEY.

Note by the Communicator.—The following paper is the preliminary report of a series of investigations that are being undertaken by the School of Education of the University of Illinois to determine the relative merits of the pure-science and applied-science methods of approach in the teaching of secondary-school science. This question has long been a source of controversy among high-school teachers. It will be noted that the present study has been undertaken not to determine the relative influence of the two methods of approach upon the later, economic adjustments of the pupil, but rather to determine whether the economic approach will or will not influence the disciplinary or cultural outcome of his science work. In other words, the pure-science and applied-science methods of approach are both tested by a pure-science standard. Similar tests are being undertaken during the present semester in the teaching of botany, and it is planned to continue them in connection with physics and chemistry. It is understood, of course, that the ultimate validity of conclusions reached by the application of the method herein described will be strictly conditioned by the degree in which the "personal equation" of the experimenter is amenable to control. This problem can be solved only by a careful analysis of the results of repeated experiments.—W. C. B.

SUMMARY OF RESULTS.

1. The results are only suggestive, in view of the small number of individuals tested. Even allowing for the probable error, however, the applied-science method of approach to the study of secondary-school zoölogy appears to have a slight advantage over the pure-science approach, when tested by examination-grades (the examination being of

the pure-science type). When tested by average semester grades, the applied-science approach shows a somewhat greater advantage. When tested by the per cent. of pupils averaging more than 85 per cent. in the semester's work, the applied-science approach has a slight but appreciable advantage.

2. When tested by the ability of the pupils to set up experiments and interpret phenomena (a cultural and disciplinary standard), the applied-science approach has a decided advantage.

3. When tested by the interest aroused as revealed in the voluntary "outside" reading of the pupils, the results are uncertain.

4. The method of investigating class-room problems by comparing the progress of parallel groups of pupils promises to yield valuable results, but it should be carefully studied, and its technique refined through repeated tests.

I. PURPOSE OF THE EXPERIMENT.

The following experiment is an effort to contribute some definite and tangible data for the solution of the problem of the relative merits of these two methods of approach to the study of zoölogy.

II. METHODS AND RESULTS.

The method of conducting the experiment, by the use of parallel groups (employed perhaps most notably by Winch in his memory investigations), is comparatively new, and should prove of service in questions of method of teaching such as the one under consideration.

The experiment was performed in the Academy of the University of Illinois during the first semester, 1909-10. Two sections of the class of beginners in zoölogy were used. These sections were approximately equal in size. They used the same laboratory and apparatus, the same text-books and laboratory guides, and were both taught by the writer. The same subject matter was covered, and the same examination

questions and tests were given to both groups. No selection of students for either section was attempted. Furthermore, the students were not informed of the experiment either upon registration or during the semester. They could not, therefore, choose one section or the other because of individual preference.

The data summarized below seem to indicate that the two sections were fairly equal with respect to distribution of sex, age, former environment, and professional bent. In computing the averages one student (42 years old) was not considered.

NUMBER IN SECTIONS: A, 17
B, 15

DISTRIBUTION AS TO SEX: A—boys, 15; girls, 2
B—boys, 13; girls, 2

AGE:

Average age—A, 18.7 (average variation, 1.0)
B, 19.1 (average variation, 1.7)

Median age—A, 19
B, 18

FATHERS' OCCUPATIONS:

A—agriculture, 6; medicine, 1; other occupations, 10
B—agriculture, 6; medicine, 0; other occupations, 9

STUDENTS' FORMER OCCUPATIONS:

A—4 have worked on the farm; 5 in other occupations
B—4 have worked on the farm; 5 in other occupations

STUDENTS' INTENDED OCCUPATIONS:

A—agriculture, 1; medicine, 3; other occupations, 13
B—agriculture, 0; medicine, 2; other occupations, 11; undecided, 2

Throughout this report the so-called cultural and disciplinary group is known as Section A. The enrollment was 17—15 boys and 2 girls. It recited from 8 to 10 a. m. The so-called economic group is called Section B. The enrollment was 15—13 boys and 2 girls. It recited from 11 a. m. to 12 m., and worked in the laboratory from 1 to 3 p. m. It should

be noted that Section B recited at a period of the day not so favorable for the best work as that used by Section A. (Cf. Burgerstein and Netolitzky: *Handbuch der Schulhygiene,* Jena, 1902, p. 572.)

A brief statement of some of the differences in approach and treatment of some topics used will best explain the method of conducting the experiment.

Illustrative Details of Methods of Instruction.—In studying the mouth parts of insects, Section A inquired as to the significance of these structures and adaptations in enabling the possessor to maintain its existence and be successful as a living creature. Section B made the same inquiry, but dwelt upon this significance for a shorter period and asked at some length the economic importance of these structures and their adaptations to the destruction of crops and property and to the spread of disease.

Section A visited a market garden and found aphids upon the vegetables, particularly upon cabbage plants. They studied such points as the great numbers, wide distribution, rapid multiplication, suctorial mouth parts, parthenogenesis, etc., of these creatures as factors which make them successful as a species. Section B found the same aphids and discussed the same points more briefly. They then considered the extent of the injury done in the garden and how parthenogenesis, rapid reproduction, and wide distribution of aphids contribute to the destruction of vegetables and other crops. Section A discussed the sucking mouth parts of aphids, squash bugs, and other Hemiptera as adaptations which enable these insects to employ a particular method of obtaining food from beneath the epidermis of the food-plant or animal. Section B noted the same points, but gave considerable time to a discussion of the fact that this particular type of mouth parts is responsible for the very large number of exceptionally injurious species to be found in this order, such species, for example, as plant lice, scale insects, squash bugs, cicadas, chinch bugs, bed bugs, etc. In this connec-

tion it was pointed out that the arsenical stomach poisons used effectively against the Colorado potato beetle and similar insects with biting mouth parts are of little service against this group with beaks, which may pierce the epidermis of the plant and suck the juices from beneath the coat of poison. Therefore, if the Hemiptera are to be destroyed artificially, it must be in some other manner, as by contact poisons in the form of washes and sprays, or by the fumes of poisonous gases. It is manifestly far more difficult to place poison in contact with each individual insect than to spread it upon vegetation where biting jaws would devour it. In the study of the mouth parts, then, the economic section saw a partial explanation of the large per cent of Hemiptera which are both injurious and difficult to control. This discussion was followed by a brief study of methods of controlling injurious Hemiptera.

Section A observed the lady bird devouring aphids to satisfy its appetite and maintain its existence. Attention was called to the fact that the little insect gives off a fluid which is distasteful to birds, toads, etc., which might otherwise feed upon it. The class observed that the lady bird is conspicuously marked, and, remembering that it is unpalatable, concluded that this might well be considered a warning coloration. Section B noted the little beetle devouring aphids, and, knowing the harm done by plant lice, at once concluded that the lady bird is exceptionally beneficial to man. They discussed, also, the bad tasting fluid which repels enemies, and noted the conspicuous color, but looked upon these provisions as fortunate means of protecting the very valuable little creature from destruction by predaceous animals.

Section A found tomato worms and noted their food, their color corresponding to the foliage, their means of holding on to the stems, the parasitic Hymenoptera emerging from the caterpillars, and the weakened condition or death of the tomato worm as a result. Section B noted all these points, but estimated the damage done to the patch of tomatoes, figured the per cent. of parasitized forms, and concluded that

a very large per cent. of these insects are killed by the parasite, and that the ultimate damage done by them is perhaps correspondingly diminished.

The tongues of the frog and toad were discussed by Section A as organs especially adapted in point of attachment and in structure for obtaining insects used as food. Section B looked upon the organ as one not only enabling the toad to get its own food, but also as one which fortunately enables the toad to perform great service to man by destroying injurious insects on farms. Section A observed the extensible horny-tipped tongue of the woodpecker as a structure used to spear and extract the grubs from the trees after the chisel-like beak has made the opening in the bark. Section B saw in this structure a means not only of obtaining food for the bird, but also a means of saving our forest and fruit trees from grub and borer injury to the amount of many million dollars annually.

Section A discussed bird migration, noting its causes and its effects upon the bird population of the region and upon the species migrating. Common birds were classified as permanent residents, summer residents, winter residents, transients and accidental visitors. Section B discussed the effect of migration upon the food of the bird, and on the insects and weed seeds destroyed in a given region. If a bird's food habits are good, it is most beneficial in the locality if it resides there permanently. It perhaps is of next greatest value if it is a summer resident and nests in the locality. This is particularly true since young birds are so frequently fed upon injurious caterpillars and grubs. Each group of migrants was discussed with reference to the value of its individuals in an economic way. To Section B this classification meant in part, that a bird was of greater or less value on the farm and in the forest accordingly as it fell into one or the other of these groups.

In like manner Section A learned the distribution and number of birds in pastures, plowed fields, forest, etc., where they obtain the particular foods they most desire. Section

B learned this distribution and asked what significance it might have in holding in check the particular destructive insects found there.

The preceding examples, while not given in great detail, will indicate some of the differences in points emphasized in the two sections.

Methods of Testing.—Perhaps few experiments are more complicated than the one here undertaken. Numerous factors enter into the results, and some of these factors are not easily controlled. For example, by reason of previous training or occupation some students in Section A may have developed strong economic tendencies, which might easily serve as a source of interest in the study of biological forms. This would tend to minimize any real advantage gained by the economic section. Furthermore, much difficulty was experienced in the development of a technique. In fact, the solving the problems of method rather overshadowed the obtaining of definite data, and must continue to do so, in a diminishing degree, until the method of attack is perfected.

Results were compared mathematically upon:

1. The amount of zoölogical knowledge assimilated.

2. The power to set up simple experiments and to interpret phenomena.

3. The interest of the sections.

The Examination Test.—The amount of knowledge assimilated was tested in the usual way, by written examinations, the same questions being given to both sections. Every effort was made to avoid the economic element in the questions asked so that Section A would be under no disadvantage. The questions were made to cover the field of study pretty generally and to search the ground rather thoroughly. The final examination questions will serve as a type and were as follows:

1. Define the following zoölogical terms, and give an example of each: *mimicry, homology, analogy, instinct, intelligence, parthenogenesis, exoskeleton, endoskeleton, vertebrata, imago.*

2. Discuss the relation of insects to disease.

3. Discuss the relation of insects to flowers. (Omit discussion of the milkweed studied in the laboratory.)

4. Give the life histories of the *mosquito,* the *housefly,* and the *frog.*

5. Define *evolution, natural selection, hybrid, dominant.* State Mendel's law of heredity as it applies to white and grey rabbits.

6. Compare the respiratory and circulatory systems of the *locust,* the *crayfish,* the *frog,* the *bird,* and the *rabbit.*

7. Give characteristics and examples of: *Orthoptera, Odonata, Hemiptera, Coleoptera, Diptera, Hymenoptera.*

8. To what class and order does each of the following animals belong: *Ostrich, owl, bob-white, cat, horse, crayfish, green-frog, butterfly, black-snake, man?*

9. Define *carapace, cephalothorax, somite, exopodite, palpus, metathorax, ocelli, gastric mill, cheliped, cerebrum, amoeba, arthropoda.*

10. What animals can you find abundant in the fall in cabbage fields and gardens, in weed and stubble fields, in stagnant, filthy water, such as that near the Smith Packing House, in the dredge ditch, in a dusty road? (Recall your field trips.)

Results of the Examination Test.—The examination papers were numbered and the grades recorded before the names of students holding these numbers were known to the instructor. This was, of course, done to eliminate the personal equation in judging results. Section A made an average grade of 72.5% on the final examination, while Section B made an average grade of 73.2%.

Results of Comparing Semester Grades.—The average semester grade for all subjects other than zoölogy of the students in Section A is 80.35%. In zoölogy the average of the same students for the semester is 81.53%. The average semester grade of the students in Section B in all subjects other than zoölogy is 78.47%. In zoölogy their average for the semester is 82.73%. Section A, then, has an average in zoölogy which is 1.18% higher than their average in other subjects. Section B has an average in zoölogy which is 4.26% higher than the average in other subjects. In all subjects other than zoölogy Section A has an average which is 1.88% higher than that of Section B. In the final examination, however, Section B has an average grade which is 0.7% higher than that of Section A. After calculating the probable error in all the data obtained, a very slight advantage appears in favor of the economic approach. While this advantage is too small to warrant any final conclusions upon a single trial of the experiment, it does warrant the conclusion that the experiment is worth repeating with the hope of obtaining more conclusive data as the technique is perfected.

Results of Comparison of Pupils Averaging Over 85%.—Viewed from another standpoint, the grades are even more interesting than is indicated above. The per cent. of students making above 85 was 29.4 in Section A and 46.6 in Section B. The per cent. making from 75 to 85 was 41.1 in Section A and 33.3 in Section B. The per cent. making from 70 to 75 was 23.5 in Section A and 13.3 in Section B. This seems to point to a rather clear advantage for Section B. However, if this advantage exists in a rather marked way as indicated in these figures, it may be asked why the average of Section B is so little above that of Section A. The fact of the matter is that in Section B there was a case of premature love-sickness, a thing which high-school teachers will admit is difficult to control so long as the parties are thrown together in the class. Perhaps no method of

presenting subject-matter will greatly influence such cases. These two students materially lowered the average of Section B.

Frequency curves, not published in this preliminary report, were plotted both for the examination grades, and for the pupils averaging over 85. They show a uniform advancement of the "stations" of the various groups in Section B, as compared with analogous groups of Section A, while the frequency curves for grades in other subjects show the inverse relation.

The Test for Ability in Experimentation and Interpretation; Its Results.—The following is an example of the method used to test the ability of students to set up experiments and interpret the phenomena. The supply table was provided with all necessary containers and apparatus for transfer of materials; with thermometers, food materials, etc., for the experiment. Mosquito larvae of uniform age and size were placed on the table, and the classes were directed to determine by experiment the effect of abundance and scarcity of food supply upon the rapidity of growth and development of mosquito larvae. The individual student was then required to write out a detailed account of the steps to be taken and present this for approval. This precaution prevented the possibility of students getting suggestions by seeing other students at work on the same problem. Defects such as failure to specify that the containers in the experiment must be placed under the same temperature and light conditions were checked against the student, and he was required to make a second report. Of students in Section A, 35% reported correctly on the first trial, and 47% more were correct on the second report. Of students in Section B, 60% reported correctly on the first trial, and 33% more were correct on the second trial. This gives an advantage on first reports in favor of the economic section.

The Test for Interest and Its Results.—As to interest, while the writer is confident that much the greatest advantage in favor of the economic section was found here, he does not care to represent this difference in mathematical terms until he has better control of some of the factors involved. Readings from Burroughs, the Peckhams, Darwin, Huxley, Wallace, DeVries, Jordan, Kellogg, etc., were assigned to Section A. Readings from numerous bulletins from the Department of Agriculture at Washington and from the state experimental stations were assigned to Section B. Records of voluntary readings by the two sections were somewhat vitiated by the fact that books wanted were frequently in use by other departments of the University. Figures are, therefore, not given on this point. Interest, however, both in the regular class work and discussions and in the outside work seemed to be greater in the economic section, and it was here that the results seemed to be most favorable to the economic approach. More definite and reliable data can be obtained on this point in future experiments.

III. CONCLUSIONS.

One chief concern of the writer in performing this experiment was to satisfy his own mind as to the feasibility of getting data of real value by this method of experimentation. The only definite conclusions which the experiment justifies are that the method, with such modifications as experience will bring, can be applied successfully, and that the problem of the relative merits of methods of approach to zoölogy is worthy of serious consideration and experimentation.

During the present semester the writer is continuing the experiment, under some difficulties, on two sections in botany. It is intended to repeat the experiment in zoölogy next year in the light of the experience gained in this first attempt. Some modifications will certainly be made, but it was deemed best to give the account just as the experiment was performed, and without comment as to either the stronger or the weaker features involved.

The writer is very anxious that other teachers interested in this type of pedagogical problem should try the method here suggested, and that they should contribute first to the development of the needed technique, and finally to the determination of the best method of approach to the study of biology.

The Ministry of Education in Prussia is making an interesting attempt to bring the primary and secondary schools into closer relations with each other. The principal of the secondary school is to visit the primary schools in his locality from time to time, give suggestions and advice to the directors and teachers of these schools, and preside over the promotion examinations. This will tend to secure greater harmony in the methods and work of the two schools, and will facilitate the passage of pupils from the one to the other. The plan is worthy of imitation in this country, and might greatly increase the efficiency of our elementary schools.

In the Berlin Teachers' Association a section has been organized for the experimental study of pedagogical problems. In its "program" the section recognizes the dependence of a scientific pedagogy upon the methods and investigations of child and experimental psychology, but calls attention to the fact that the period of child development from the ages of 6 to 14, the period of the greatest importance for the teacher, has been very little studied. This field offers alluring opportunities for the psychologically trained teacher, and the section will devote its energies to the organization of appropriate investigations and to the collection and publication of their results.

AN EXPERIENCE WITH CORRELATION AND THE CLASS EXPERIMENT.

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Encouraging results in teaching by the writer have followed emphasis upon: (1) definite correlation of the introductory course in psychology with basal studies, and upon (2) the class experiment. Welcome to him, therefore, is the suggestion of Professor Seashore (this JOURNAL, Jan., 1910), that psychologists should co-operate to prepare a series of exercises suitable for class-room use. He says there are four ways in which we may teach psychology by experiment: (1) the regular technical laboratory course; (2) the exhibition experiment before a class; (3) the individual experiment without apparatus; (4) the class experiment. This fourth way requires that the student should take active and responsible part in the experiment, that the experiment should be sufficiently intensive to make it vital, and each step must be explained and interpreted. Each of the four ways is valuable in its place, but it is evident to us that the class experiment offers superior merit.

Added to the needed application of the class experiment, a matter to which we shall return, it appears that an equally urgent need is a more vigorous readjustment of our curricula so that courses in psychology may not be undertaken except by students with a modicum of preparation in physics, chemistry and biology, as well as in history, literature and language. This conviction is the result of some years' trial of different methods of instruction in psychology, e. g., use of textbook, lectures, individual experiments—in dealing both with normal school and with college students,

who expect to teach. The experience of these years will be summarized in what follows, as: (1) preparation found appropriate for introductory courses in psychology; (2) a sample class experiment as adopted and justified in use.

1. Irregularity of preparation in students both of normal school and of college courses is due to manifold causes, such as: lax entrance regulations, differences due to age, capacity, health and sometimes to electives not safeguarded by wise grouping. Once a class is before us, the insufficiency of preparation is not easily remedied. If attacked in time, one remediable cause of unfitness for psychological study is the failure to correlate in advance the departments indicated. I have heard of students studying in the order named, as follows: educational psychology, philosophy and psychology, and afterwards chemistry, physics and perhaps neurology. One strong youth, a victim of such labor, confessed to me that his whole course seemed largely a maze of unrelated and half-forgotten details. To overcome by correlation a confusion of studies it seems would be something more than mere subservience to logical order; the principles of growth demand it. And for the sake both of economy and apperception the value of consecutive arrangement of courses aside from theory appears to us practical and certain, as the outcome of actual trials with groups of students with and without the benefits of such correlation. The arrangement of studies here noted has regard especially for the assimilation of psychology as a basis for educational theory, but the principle seems valid also when psychology is undertaken for other specific aims or for general culture.

The trials referred to concern three years' endeavor with normal school and with college students, in an institution which was practically a normal school having courses respectively of two and of four years, intended for the preparation of teachers for elementary and high schools. Local conditions, one of which was the failure of the state to provide any normal school, made it impracticable to eliminate sum-

marily the normal school courses; and on the other hand, the expectation of developing a true teachers' college with independent endowment made necessary the college work. The new George Peabody College for Teachers, which has received the expected endowment, will represent the culmination of the hopes in reference to a teachers' college.

Three years of transition and development in the old institution afforded the writer some opportunity to observe the effects of devices in his work of instruction. During the first year he was forced to receive students with slight uniformity of preparation. During the second year faculty legislation was secured which required of students upon entering psychology that they should have had about two quarters' work, including laboratory exercises, in each of the three sciences, physics, chemistry and biology (with stress upon the physiology of the nervous system). Average preparation in mathematics, history, literature and languages was also secured. Legislation further effected the separation of the normal school and the college work by formation of separate class-groups, and the standard of admission to the first was made 8½ Carnegie units and to the college 14 units. Hitherto the regular courses had been interchangeable for credit in either normal or college department. The distinction made in standards, the better grouping of students and the adaptation of the nature, quantity and quality of work respectively to the two general groups obviously were beneficial. The conditions were not altogether unique in America, although the causes thereof were unusual. They are recorded here as explanatory of our efforts for correlation as well as being suggestive possibly to institutions whose curricula remain in an undefined, confused state. Where summary amputation is impossible, an ameliorative treatment consists in the actual separation of classes and the correlation of studies, with regard for the specific aim of the institution.

Looking backward we know that the normal school year, with its rigid curriculum having no electives, was overcrowded. Semesters would have been better than quarters for the plan executed. Nevertheless the zeal and understanding manifest in the large elementary classes of psychology were better than hitherto. In the college psychology (Junior class) the results were gratifying in marked degree, as evinced by comparison of general observation of the relative character of habits and knowledge, as contrasted with those of previous classes, as well as by the criterion of class records. It is hoped also that the effect of the measures adopted will help the students to make good choices from the wide range of electives offered during the Senior year of the college course. The preparation and character of the class as a whole made it possible to utilize the class experiment more than heretofore.

The first quarter's work (twelve weeks) was followed by the course in educational psychology. The texts used during the first quarter were Ebbinghaus (Meyer) and Seashore. During the second quarter Bagley's Educative Process, supplemented by frequent reference to Adolescence (Hall).

2. The class experiment utilized with most benefit was an adaptation of Seashore's simple directions (Elementary Experiments, page 131) for the simultaneous use of the college class. There were fourteen students in the group. Upon a heavy white cardboard (43 x 91 cm.) pegs (brass pins) were glued in 24 different positions. Upon white cards (9 x 10 cm.) geometrical symbols were marked with blue ink. Another set of symbols was made by marking the back of same cards. Dennison's cloth suspension rings were used for hangers. A few familiar symbols, Greek letters, were purposely included, but the geometrical designs were generally different from Seashore's, which each student had seen perhaps in his book. The symbols with meaning of course served to bring out vividly in the data the factors of association and interest.

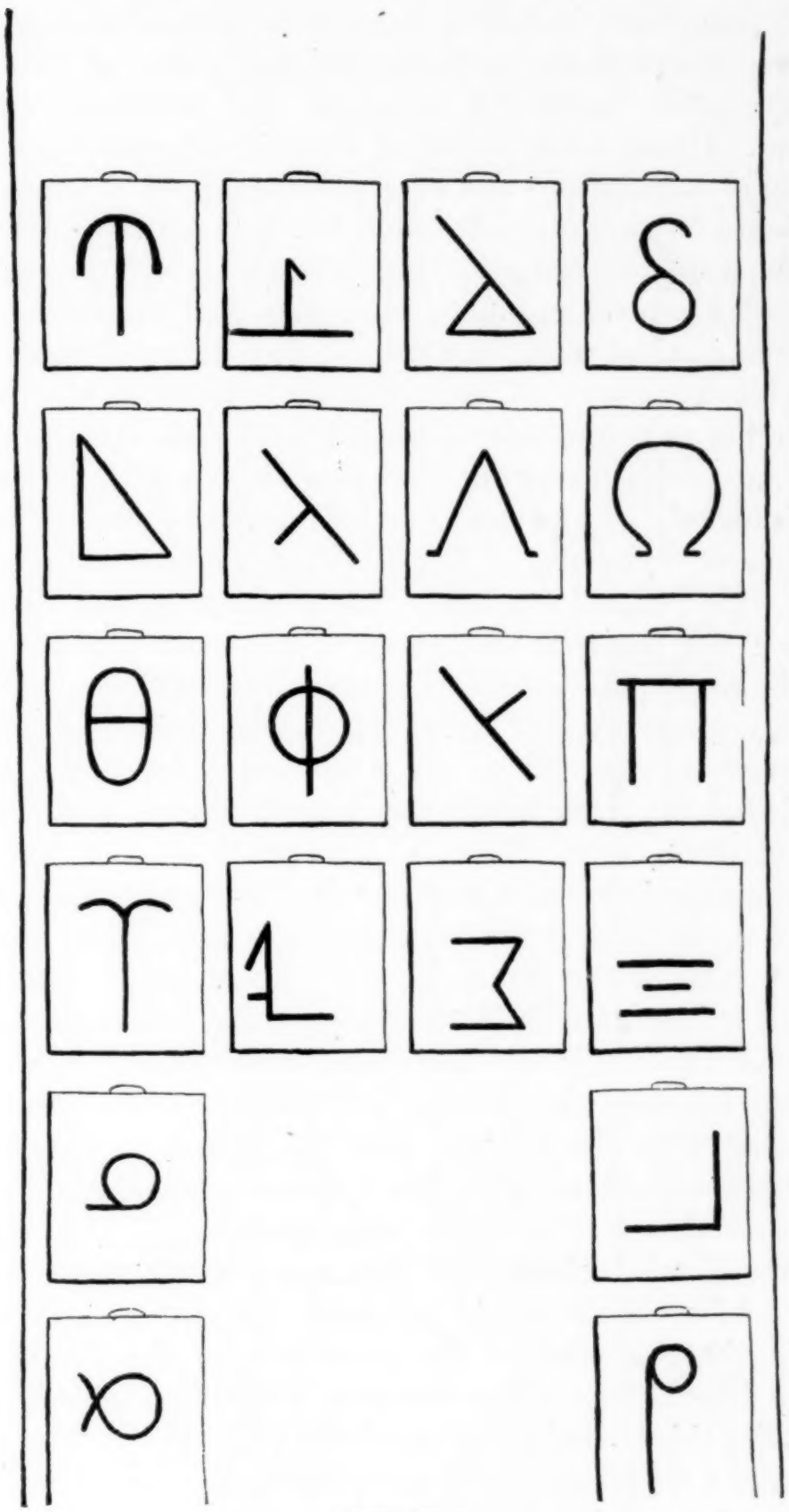

FIGURE I.

The procedure, including exposures, recording data, explanations, comparisons and discussions, occupied two weeks. We are still discussing some of the problems naturally evolved. Home-work consisted in assigned readings, and the making of calculations and of graphical representations. Care was taken with notebooks and habits involved; systematic records were exacted; the data were grouped separately on the pages from the opinions, inferences and problems. In the class the method was: on the first day, after distribution of eight blank papers to each student, and following careful instruction as to procedure, records and evaluation of results, eight successive exposures were made, each of 15 seconds, with intervals of two and one-half minutes for writing the remembered symbols. (Fig. I.) The papers after each interval were put out of sight. The grading agreed upon was: value of five per cent was given to a correctly made symbol in right order; a value of two and one-half per cent for a correctly made symbol in wrong order. The remainder of the hour was devoted to recording introspections. On the second day the experiment was repeated with same symbols grouped differently. (Fig. II.) The third day was spent in comparing introspections and in the examination by the class of the graphical representations (made by the students) of the results of the two tests. The curves were tacked upon the wall temporarily in order to expedite comparison of results and the study of individual differences. The introspections revealed the random processes of some students as contrasted with the devices used by others in memorizing, and also some interesting facts concerning imagery. The whole and the part methods were discussed. The students were urged to do better on the morrow when an entirely new set of symbols would be used. It was expected incidentally that because of the practice and the ideals inculcated so far, that some improvement would be shown in reproducing the third new set of symbols (Fig. III.) The record (Fig. IV), a reproduction of one made by a student, is typical and indicates a failure to register marked improvement with

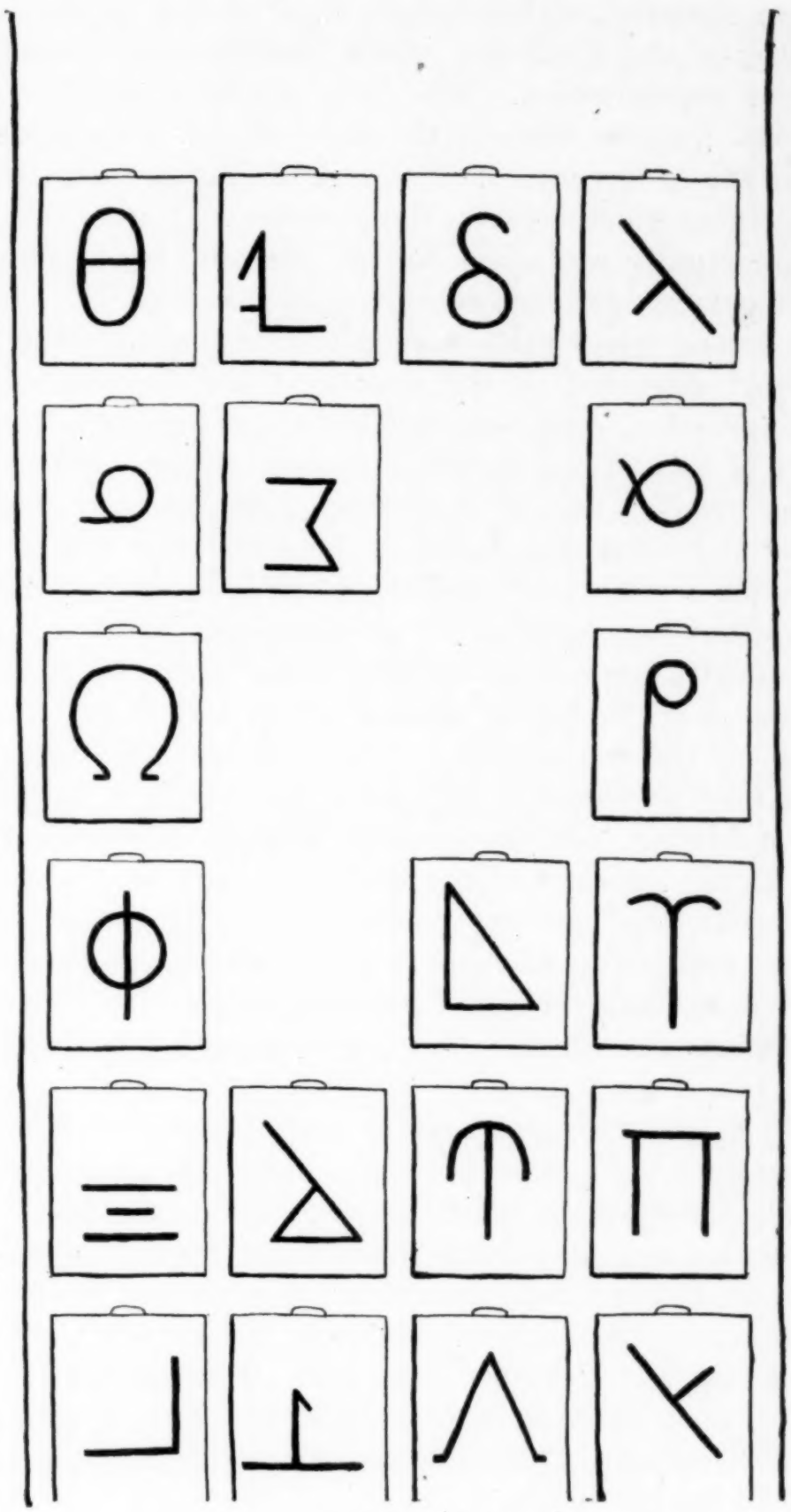

FIGURE II.

the new material. This failure may be due to the greater difficulty of the third set, which therefore demanded more time for reproduction. The lines A, B, C in this record represent for one student the data of the three groups of tests in the order named. The lack of improvement brought up questions which concern the problem of formal discipline, and opportunity was given to call attention to the numerous experiments upon the effects of special practice.

The second week was occupied in formulating some of the problems suggested in the course of the experiment, such as: "impression, retention, recollection, recognition," and the factors of repetition, recency, interest, fatigue and of association. One or two of these were elaborated by means of another class experiment. E. g., to exemplify the factor of association a mnemonic device of our own contrivance was used so that each member of the class was enabled, in spite of frequently expressed initial feeling of inability to perform the task, to repeat accurately in any order a list of disconnected words spoken to the class but once. After the feat, careful explanation was given and received with eagerness concerning: (1) the general history of mnemonic systems; (2) the impracticability and fraudulent nature of advertised "systems of memory training"; (3) the actual working of the associative function, in this case without repetition.

One could hardly claim that the getting of reliable data is the prime aim of this class experiment. But we secured in some students a measure of appreciation of the scientific method; a spirit of co-operation more intense than rivalry; perhaps some discipline in certain habits of attending; considerable information, and the class was agreeably stimulated—as no mere text-book memorizing had stimulated—to an attempt to formulate naturally the problems of the memory processes. Spontaneous inquiries were evoked, co-operation, interest and work were the rule. Finally, the complete record of each student—the data, curves, introspection, tentative conclusions and the digests of home reading—were examined by the instructor.

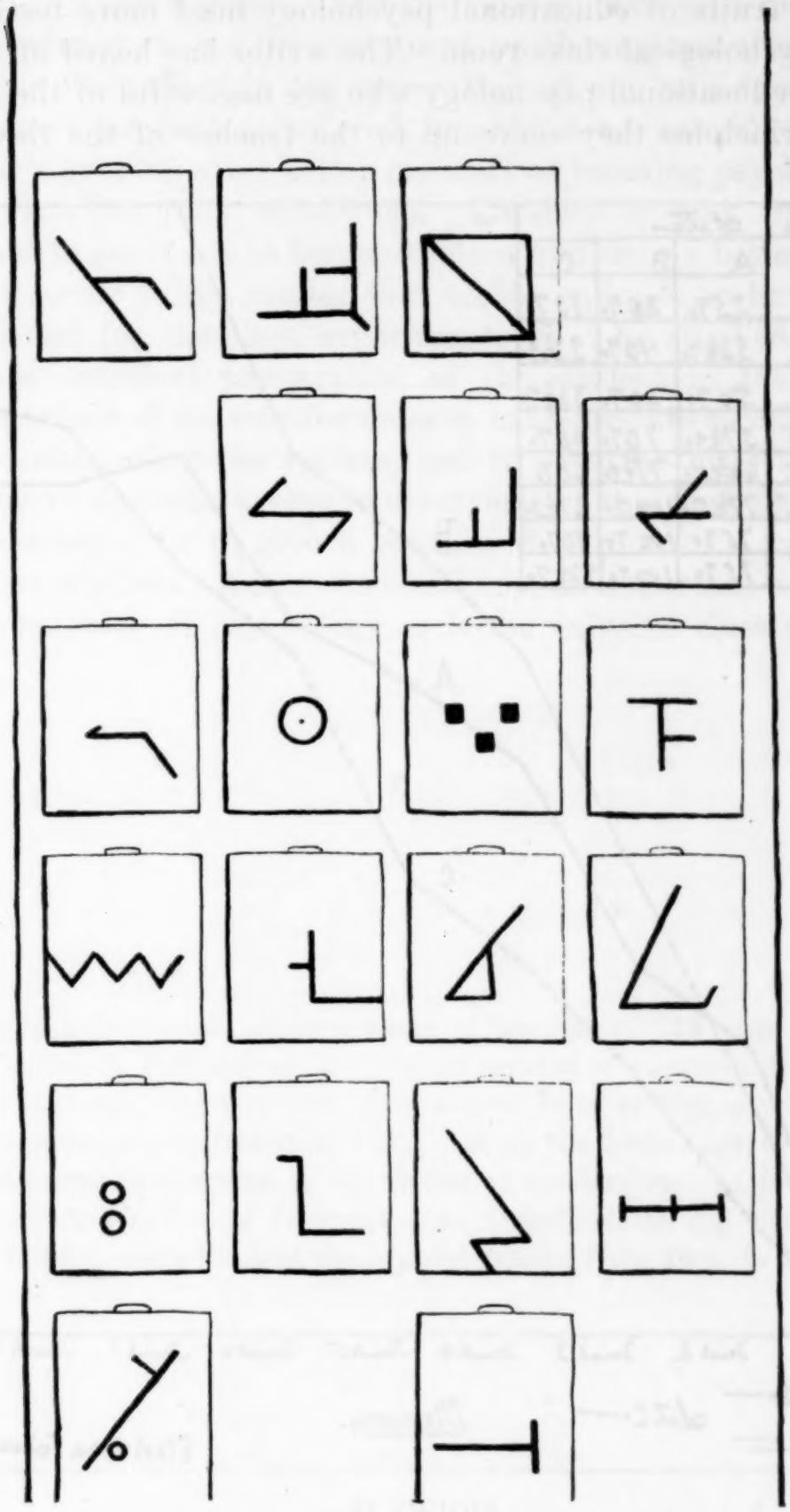

FIGURE III.

The fruits of educational psychology need more testing in the psychological class room. The writer has heard of teachers of educational psychology who are neglectful of the ideals and principles they serve up to the teacher of the three r's

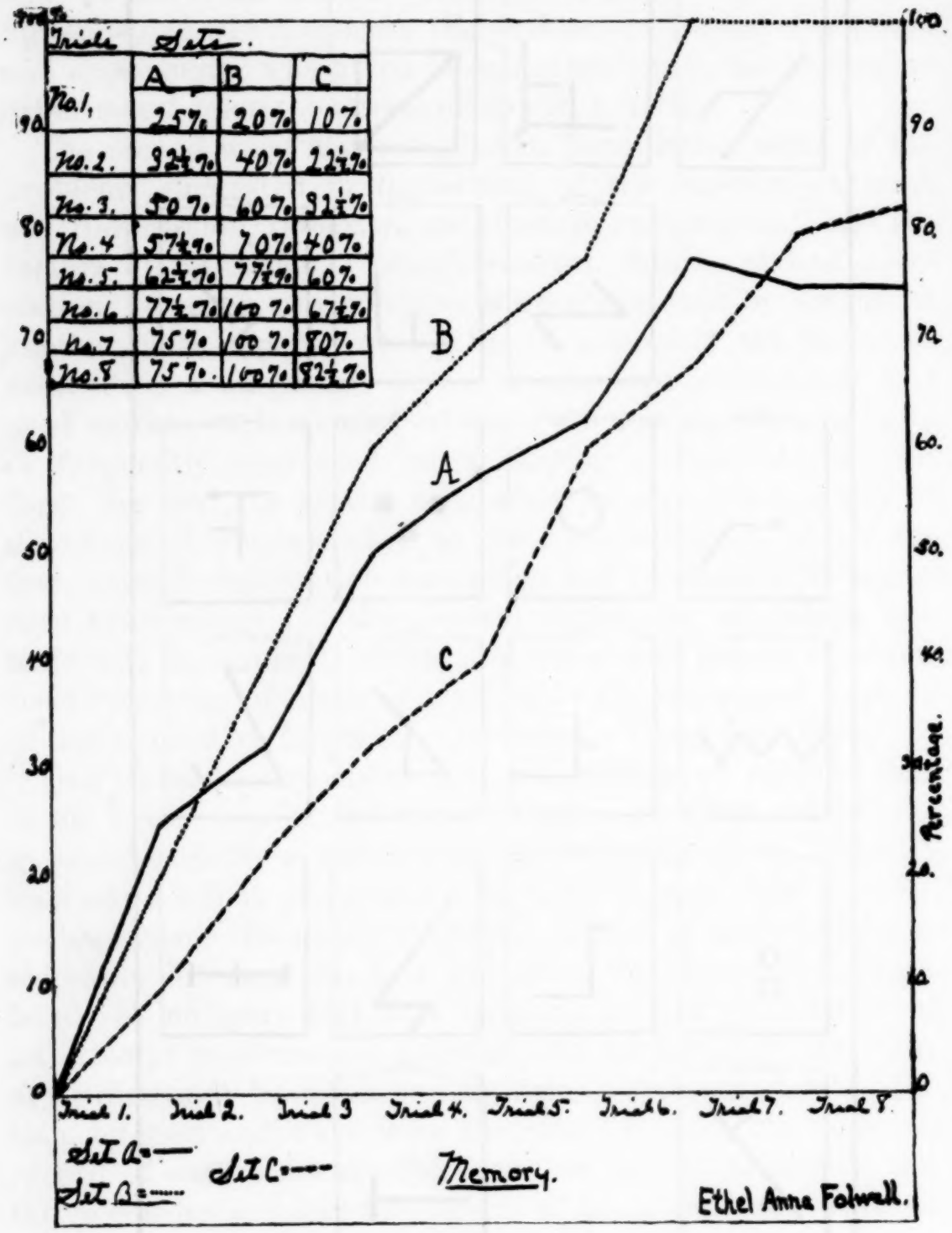

FIGURE IV.

or of Latin and algebra. For the sake of both efficiency and of consistency cannot the movement which supports this journal have first effect in the renovation of our own teaching? The above account is offered humbly as a record of one teacher's groping after better methods of teaching psychology under handicapping conditions. Possibly it may provoke someone to point out to him and fellow sufferers a better way.

If it seems to the reader that undue enthusiasm has been manifested for the class experiment, let it be recalled again that the excellent preparation of the student in the basal sciences cleared the way for an easy entrance into psychology. The teacher, after the reform, had to consume little time in pausing to describe a simple spectrum, or the working of an electro-magnet or to give a working definition of a neurone or of metabolism. Actual correlation is as important a factor in the teaching of psychology as is the valuable class experiment..

President Schurman, after a study of the list of 135 men dropped from Cornell in February of this year on account of unsatisfactory work, reports that the fraternity men show almost twice as high a percentage of failures as the non-fraternity men. Among the fraternities themselves there are great differences in the matter of scholarship. Of the thirty-seven national and local fraternities at Cornell eleven did not have a single failure, while in eight the failures ranged from 10% to 17%.

COMMUNICATIONS AND DISCUSSIONS.

SOME INVESTIGATIONS OF HABITS OF STUDY.

In the investigation of the problems of education how should the judgments or conclusions be made? "In the first place it is obvious that it [accurate judgment] can only be based on a clear knowledge of the facts, on an appreciation of their sequence and relative significance. The facts once classified, once understood, the judgment based upon them ought to be independent of the individual mind which examines them . . . . The scientific man has above all things to strive at self elimination in his judgments, to provide an argument which is as true for each individual mind as for his own. *The classification of facts, the recognition of their sequence and relative significance is the function of science,* and the habit of forming a judgment upon these facts unbiased by personal feeling is characteristic of what may be termed the scientific frame of mind." (Pearson's "Grammar of Science," p. 6.) If, then, educational conditions or problems are to be investigated scientifically there must be something more than the gathering of data and the drawing of conclusions. In order that the conclusions may be valuable the data must be collected very carefully; the manner of the collection explained fully; the condition of each investigation (where the results of the succeeding are to be compared with the preceding) duplicated exactly; liability to create false conditions must be recognized and guarded against; the danger of being blinded to real conditions by a desire to prove a theory must be avoided; and the enthusiastic or cold presentation of one side or the other of a subject eliminated.

Prof. F. M. McMurry in his book, "How to Study and Teaching How to Study," pages 5 and 6, quotes figures that are startling. His material was gathered from investigations of the subject of Study in the Grades, conducted during the last four or five years by Dr. Lyda B. Earhart. Two paragraphs are quoted: "Out of 842 children who took this test only fourteen really found, or stated that they had found, the subject of the lesson. Two others said that they *would* find it.

Eighty-eight really found, or stated that they had found, the most important parts of the lesson; twenty-one others, that they *would* find them. Four verified the statements in the text, and three others said that they *would* do that. Nine children did nothing; 158 did not understand the requirements; 100 gave irrelevant answers; 119 merely thought, or tried to understand the lesson, or studied the lesson, and 324 simply wrote the facts of the lesson. In other words, 710 out of 842 sixth and seventh grade pupils who took the test gave indefinite and unsatisfactory answers. This number showed that they had no clear knowledge of the principal things to be done in mastering an ordinary text-book lesson in geography. Yet the schools to which they belonged were, beyond doubt, much above the average in the quality of their instruction.

"In a later and different test, in which the children were asked to find the subject of a certain lesson that was given to them, 301 out of 828 stated the subject fairly well. The remaining 527 gave only partial, or indefinite, or irrelevant answers. Only 317 out of the 828 were able to discover the most important fact in the lesson. Yet determining the subject and the leading facts are among the main things that anyone must do in mastering a topic. How they could have been intelligent in their study in the past, therefore, is difficult to comprehend."

The fact that, in the first test, only 14 out of 842 really found or stated they had found the subject of the lesson, and in a later test 301 out of 828 stated the subject fairly well, is certainly startling. One is at once interested in the manner in which the tests were given. Inquiry by the writer revealed the fact that, at least in one of the rooms in which the tests were given, the conditions of the first test were not duplicated in the second. In the first test printed questions were presented to the pupils by the principal of the building. In the opinion of the teacher in charge of this grade these printed questions, given by the principal with no explanations, changed the natural free conditions the pupils had with the regular teacher. The pupils did not study as was their custom, they did not consult dictionaries or reference books as they did daily with the regular teacher in charge and therefore this first test was not a true test of the pupils' ability to study. The second test in this same room was given by the regular teacher in charge—when the normal conditions under which the pupils studied were restored. In this particular grade the pupils in the second

test consulted books of reference and dictionaries with the usual daily freedom. The atmosphere was not strained, there was no timidity, no fear, as there had been in the first test. It is to be noted that in the first test only 14 out of 842 children found the subject of the lesson, on the second test only 317 out of 828 were able to discover the most important fact in the lesson and 301 out of 828 stated the subject fairly well. If all of the tests were given in the way described, the question arises whether the improved results of the second test might not be due to the restoration of the normal conditions at the time the second test was given.

The teacher in charge of one of the rooms in which the tests were given is of the opinion that the investigators were anxious to prove a theory and, therefore, failed to observe all the requirements necessary to secure impartial results. They wished to be fair, they had no intention of creating a "situation," but they were prejudiced in favor of certain theories and the "situation" was created unintentionally.

Another teacher, in whose room these tests were given, states that the first test was given by a stranger, but "a part" of the second series of tests were given by herself "to economize time." In her opinion, "The only things that seemed to hamper the work were these facts; it was unusual for a strange man to give tests, and the fact that the directions were mostly printed on the papers, instead of being given orally." She further says the pupils in the second test worked more quickly and more intelligently under practically the same conditions, though no directions or explanations had been given since the first series of tests. Why? If no directions or explanations were given between the series of tests, why should the pupils work more quickly and more intelligently in the second than in the first? May it not have been due to the fact that the regular teacher and not a stranger was in charge? However, this teacher believes the conditions were perfectly fair, and without conscious or unconscious influences being exerted upon the class.

There is no disagreement with the statements that children waste time and energy in incorrect methods of study; that they need to be taught to study, or that they can be taught to study correctly. All this is true, and the books that will help to bring correct methods of study to the attention of teachers and create an awakened interest in this most important phase of teaching are valuable, but there is some doubt about the assumed present lack of ability to study on the part

of the pupils in the public schools. If the figures given in the two paragraphs quoted above are correct, teachers are securing marvelous results even though pupils cannot study. The question is, Do not pupils study better than the above figures state (though they should study more intelligently than they do now)?

A sixth grade, in many respects not up to the usual standard, in the training department of a state normal school was examined to see what preparation had been made for the reading lesson. The usual assignment was made by the teacher in charge, special care being taken that nothing out of the ordinary routine be suggested. The following day paper was given the pupils and they were asked to state what they had done in preparing the lesson which was to follow. Nineteen replies were received. Five pupils confessed they had made no preparation, because of lack of time. Of the fourteen remaining, eight, or 57+%, stated that they "read the lesson once," or "several times," without specifying how they read it. Two of the eight added they had looked up the words which they did not know. Another of the eight "tried to pronounce every word correctly," another "tried to get the pictures." The rest of the class, or 42+%:—

Read the lesson silently, then orally,
Spent the most time on the hardest paragraphs,
Tried to find out what the story was about,
Noted the new words, then looked them up,
Thought about the story with the book closed,
Found the main idea in each paragraph,
Read the lesson aloud just as well as possible to get the expression.

Of course, this is the result of an examination conducted in but one class and only fourteen papers were counted, but the results from these fourteen show that these pupils, at least, have better habits of study than the figures quoted by Professor McMurry would seem to suggest.

Again, 118 pupils, graduates of the eighth grade country schools, who had entered the normal school in September, were examined at the end of fifteen weeks' work to ascertain what preparation had been made for the reading lesson. The assignment was: "Prepare the lesson just as well as you possibly can," then the name of the selection to be read was given. At the next recitation paper was distributed and the pupils were asked to state what they had done to prepare the lesson "just as well as they possibly could." The tabulated results follow:

Read the lesson silently	62
Read the lesson, not stating how	23
Looked up unknown words	46
Applied the words after looking them up	19
Tried to get the thought	57
Thought about what had been read	34
Read lesson aloud	72
Read lesson trying to give thought to others	7
Looked for emotion	28
Looked for pictures	68
Looked for articulation	8
Looked for enunciation	7
Looked for punctuation	10
Looked for grouping	47
Only described facts in the story	7

The results of this examination of 118 students show that the habits of study are not quite so poor as one might conclude from the figures taken from Professor McMurry's book. Of course, one must remember these 118 pupils were older than the 828 examined by Miss Earhart, but one must also remember that many, at least, of those 828 were pupils in city schools, while the 118 pupils had studied only in the country schools. The only object in quoting the above figures is to suggest that in all probability the pupils in the grades are not so helpless when a task is given as we may be inclined to think.

If progress is to be made in education, information concerning the present conditions must be available, and the questionnaire is one good way of securing this information, but much care must be taken in presenting these questionnaires and in formulating conclusions from the statistics gathered by them. The purpose of this article is to suggest that more care in the gathering of school statistics may show that the schools are not in the horrible condition that some critics seem to think.

For one to attempt to discuss a subject in which one makes no claim to expertness may seem, suggests Professor Dewey, presumptuous. But the problem of teaching may be helped if "all of us frankly" . . . "state our own convictions, even if thereby we betray our limitations and trespass where we have no rights save by courtesy."

F. S. LUNT.

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ABSTRACTS AND REVIEWS.

F. M. McMurry. *How to Study and Teaching How to Study.* (Boston: Houghton, Mifflin Co., 1909. Pp. 324. $1.25.)

This is one of the most interesting books in education written within the last few years. It is a masterly analysis of the art of study, a genuine contribution to the subject, and while the book is not precisely a pioneer, the scope and uniqueness of the treatment give it a solitary and commanding position in its field.

McMurry finds eight requisites of economic study. (1) The child must at the very outset feel a definite, *specific* purpose or need in his study—not the vague, *general* aim to acquire knowledge, culture, efficiency, power or skill, but some specific problem in the lesson assigned. This will supply a vital interest to energize effort, focalize and sustain attention; it will transform knowledge-getting from a mere collecting of facts at random to a discriminating choice of data relevant to the specific aim; and it will divert knowledge into practical channels. (2) Pupils should be taught to organize their reading matter around these leading points, and to subordinate the supporting data in the order of value. This involves keeping the central thoughts clearly in mind, the rapid gleaning or neglect of the unessential details, and the observance of a certain procedure in teaching. (3) Since the text must treat topics fragmentarily, require the child to reconstruct and supplement the text-book treatment by his own ideas and experiences. This requires the use of developmental instruction, texts with abundant details, emphasis on reflection as against verbal repetition, and versatility in methods of reproduction. (4) Children should be encouraged to assume a critical attitude toward what they read, and to pass independent judgments upon the credibility of the statements in print, owing to the fact that the latter are often exaggerated, one-sided, inadequate or false. (5) They should likewise assume an unprejudiced, tentative attitude toward knowledge, because many of our conclusions are possibilities or probabilities rather than established certainties, because our attitudes are so prone to become dogmatic and ultra-conservative, and because children incline to base their opinions on authority rather than reason. (6) Studying also involves memorizing, but its importance has been grossly exaggerated in past

educational practice and theory. It has been made the pack horse of education, becoming practically synonymous with studying, so that children have rebelled against the intolerable drudgery of school life. The drill likewise has usurped too much attention, and has been a prolific cause of educational waste, stultifying instead of nourishing the child. This chapter, in contrast with the others, is destructive rather than constructive in tendency. (7) Children should be obliged to apply the information gained through study, since use or adaptation to environment is the end-point of ideas, of the capacities and abilities of animals and men, of the subject-matter of any branch of study whatsoever, and of all education. This is the goal of ideals as well as ideas, and can be realized not only in manual and constructive execution but also in skillful talking about the subject-matter. (8) Lastly, there should be ample provision for individuality in study. So far as *study* is concerned this chapter is largely superfluous, as it is, or might be, adequately treated under the fourth factor above. The author, however, treats the topic in relation to the wider work of the recitation. Each of these factors is richly illustrated by anecdotes or concrete examples, and, throughout, the attempt is made to show that the child is capable of studying in the manner required and to suggest definite rules to guide the teacher in training him to do so.

Excellent as this book is it is not invulnerable against the darts of adverse criticism. While the points developed are set out *seriatim* and developed with commendable clearness, the book is extremely diffuse and repetitious—faults which our author will probably regard as virtues, in view of his contention that proper study involves neglect, or a rapid skimming of secondary material. Much of this repetition might have been obviated by a better sequence of the chapters.

With respect to the relative emphasis to be placed upon the various factors themselves, there is abundant opportunity for differences of opinion. The fact that it would be advisable to teach the more mature pupils to skip and skim in their reading does not imply that this is proper for the younger pupils. Not only so: I believe such practice would prove pernicious. Not only would it tend to produce superficial readers, but the younger pupils do not possess a sufficiently adequate apperceptive basis to enable them to practice much "neglect" in reading. That tendency is now all too obvious without added encouragement. Every fact for them is largely novel and must be thoroughly

mastered, unless the continuity and content are to be sacrificed. Mature students are able to neglect the old materials in their reading without much loss, and they should be trained to concentrate on the large and novel facts.

Again, in the United States we are in need of a fine balancing of the claims of individuality and diversity as against the claims of conformity and social uniformity. It is possible so to stress the doctrine of the sovereignty of the individual as to erect an anti-social standard in education. Individualism run riot spells social anarchy. To prepare the child for social efficiency demands a considerable measure of subordination of self in the larger interests of social uniformity. To rigidly "accept yourself as you are" (p. 251) would place an effective mortgage on individual progress. Personal growth with most persons results from an attempt to approximate a model, some other personality viewed as a pattern worthy of imitation. The process of annihilating the self from the kindergarten to the college (p. 264) is largely an exaggerated picture, a bugaboo, fighting which many a Don Quixote has wasted many a shot and shell. The assertiveness, independence, disrespect for expert opinion, adult authority and counsel, and priggishness of Young America, do not stand in need of special encouragement. These tendencies are stimulated by the very atmosphere of our democracy. It is the lesson of restraint that needs emphasis. What we require is a better adjustment between the demands of individuality and social conformity and subordination. Society cannot stand the strain of too many geniuses or juvenile prigs. Social integration demands socialization rather than individualization for the vast majority of men.

To train the child to assume a critical attitude toward what he reads and to judge the worth of the statements is, of course, desirable. Yet here, too, there is danger of overreaching one's self, so far as the younger pupils and the exact sciences are concerned. In the first place, the pupil will not possess an adequate apperceptive basis to enable him to sit in judgment on the opinions of mature experts and weigh conclusions in unknown fields; and second, the constituency of our country at large, old and young, treats with scant respect the expert opinions of its specialists. In this respect we present a sad contrast to the older cultural nations of Europe or the Orient. We need to train our young to respect authorities and experts, and this demands again a fine balancing of conflicting claims.

So far as concerns the factor of use, the contrast between the cultural and liberal courses, on the one hand, and the practical, on the other (p. 198f), is largely illusory, so it seems to the writer. The cultural courses may not be immediately convertible into dollars and cents, but they are of great practicability so far as concerns implanting *ideals* to shape and guide future conduct—ideals of persistent endeavor, of conquest in the face of difficulties, of effective method, of superior values, etc.

A tentative attitude toward knowledge will, no doubt, prevent excessive and misguided action. At the same time, we learn, not by mere ratiocination, but by doing, even by misguided action. The first condition of learning is fertility of response. There is a positive danger of excess inhibition, of delayed action. Our minds may become so sicklied o'er with the pale cast of thought or with tentative feelings as to lead to mental paralysis or motor impotency. The advice to seize the first opportunity to act—to cite James—and profit by your mistakes, will probably result in healthier growth than protracted cogitation because you are not absolutely certain of your ground.

The chapter on memory impresses the reviewer as inferior to any of the others. Professor McMurry aligns himself with those who, with James, regard memory as a fixed hereditary function unmodifiable by training. In so doing he fails to utilize the recent experimental material bearing on formal training and particularly on memory transference through specialized training. The memory experiments uniformly indicate that by training the memory in particular directions we can improve it for other facts whose nature is diverse. Many of the other objections to memorizing are also, so far as my experience goes, exaggerated or largely illusory. The reviewer also finds himself in disagreement with the author's conclusions regarding the effectiveness of the drill and the inferiority of the teachers who still resort to its use. I believe that the present tendency is very strong to return to a judicious use of the drill. The reader will immediately recall the recent book by Jones on Teaching Children How to Study. It is especially with respect to this factor that Jones' treatment of study differs so widely from McMurry's. Jones solves the problem of study by dividing the children into groups, so that they may obtain more individual attention and so that they may have more time for judiciously directed seat work, independent study, and drill. Jones sounds a clarion note for the return to the drill. I have in a separate paper argued the case for the drill (this JOURNAL, April, 1910).

After all is said and done, it is a question whether *direct* classroom instruction in the art of study will accomplish as much as the indirect instruction, or training, afforded by skillful teaching. The conversion of economic *methods* of study into economic study *habits* will depend most largely upon the manner in which the recitation processes are handled by the teacher. The child automatically and inevitably adjusts himself to the demands imposed upon him by the teacher. His study habits offer no exception. Skillful testing will result in judicious study.

In any event, this is a book which every enlightened teacher should read with much care. If every teacher in the land were to follow only those suggestions concerning which we can substantially agree—and that includes the majority—much good would result to the pupils of all our schools, elementary or higher. Unless I mistake, the book will have a large sale.

J. E. W. Wallin.

Cleveland Normal Training School.

M. V. O'Shea. *Social Development and Education.* (Boston: Houghton Mifflin Co., 1909. $2.00 net.)

Professor O'Shea attempts in the first part of Social Development and Education to describe the reactions of the child to his social environment, to set forth the changes and development in these reactions during childhood and youth, and to explain them in terms of mental development; that is, he has undertaken to determine the evolutions of the child's social instincts and tendencies, to find out what the child is by nature.

The topics discussed in Part I are sociability, communication, duty, justice, respect, docility, resentment, aggression and social types. The method of treatment is to describe the manifestation of these characteristics in children, to determine their appearance and trace their development in the life of the child and to discuss individual variations in them. The descriptions are based on the author's observations, supplemented by occasional quotations from friends and correspondents. Since the treatment of all the topics is about the same, it will perhaps be sufficient if we give a brief review of the chapter on Social Types.

Children differ in the degree to which any tendency is manifested, and the length of period of its continuance. From the second year on, children differ in the general attitude of their response to the social environment. These differences in attitude may persist through life, but on the other hand the child's attitude may change before maturity. First of all, children differ as to their adaptability. Some children readily take on the manners and customs of society, others resist the demands made upon them by their elders. There are, then, the adaptable and the unadaptable, with several varieties and subdivisions of each. On other grounds of classification, we have what the author calls the "open type," to which belong children who are frank and straightforward. Then there is the deceitful type, the self-conscious type, the dramatic and the non-dramatic type. We have also the hectoring type, characteristic of the bully, and the opposite, the meek and submissive type. The author concludes that all these types are variable and plastic. "One cannot tell," he says, "from observing the social tendencies of a young child what traits will be dominant in him in maturity, though if all educative influences can be controlled and directed, it may be possible to make a rough sketch of the disposition when it shall have ceased to be plastic, or nearly so." It is difficult to see how this is possible if the type of the child is likely to change to the opposite, unless there is some way of determining whether this change will take place. No such principle is given us.

In Part II, the author undertakes, to use his own words, the "difficult and interminable task of outlining a plan and method of education designed to make the individual socially efficient." The point of view, we are told, "is that of the naturalist, rather than that of the logician, or even the moralist or idealist." The author has tried to determine what is possible to be done rather than what ought to be done in social training. The first chapters of this part are, in our opinion, quite the best part of the work. They begin with a careful analysis of the causes of decay of ancient and modern nations, together with a statement of the conditions and tendencies of our own country. In a nation's youth her people are energetic, socially efficient and manifest the social virtues. But when a nation reaches maturity and material success is achieved, her people degenerate socially and morally because they do not know how to use their leisure time. This is not inevitable. It ought to be possible so to control social forces that a

nation could endure indefinitely and never grow old. This could be accomplished if the people were developed and trained in their intellectual and æsthetic natures. Education must develop the children in other than material things. A nation of alert minds will discern and should be able to control the forces that threaten degeneration in the national life. To this end *all* must be educated, all must be given higher interests and ideals and each must be trained for social efficiency. In our own country the schools are not developing a love for genuine knowledge, we have hardly begun to do vital teaching or establish ideals that will exert a controlling influence. Formalism must be replaced by vitalism. Our great need is teachers of the highest caliber, teachers of the highest ideals and genuine knowledge. It ought, as a result of education, to be possible that each generation should grow in strength and efficiency.

The author then considers such topics as moral training and the relations of the school and home. In the former, he lays too much stress on developing moral principles and ideals in the minds of children and not enough on the matter of habit and practice. On the latter point, he tells us that "children who are taught to read, write and cipher in their homes have to be literally driven to their tasks." It occurs to us that there are some children that have to be driven to school. If modern psychology says anything on the subject, it is that the home is the best place for the education of the child. Of course, we have in mind a good home as compared with a good school.

Following, there is discussion of the topics: co-operation in group education, need of playgrounds, and problems of training, incidentally also of some growing evils of the present day. One of these evils is the early maturing of children, through taking up in early years, the customs and practices of adults. Parties, dances, fraternities and the like hurry young people into maturity. As a result of smoking, drinking, gambling and other evils, "A considerable proportion of the students in our higher institutions receive comparatively little profit from their course." As to methods of correction, the author cites the opinions and practices of many men, but makes himself no essential contribution to the subject. However, the chapters on suggestion and imitation are valuable, and their lessons ought to be taught to every teacher. One passage (p. 391) is worth quoting at some length:

"The remedy for the present condition of affairs in the village must be found in wholesome occupation in line with the natural interests of boys and girls. There must be furnished opportunities for employment that will be upbuilding,

and at the same time interesting and attractive. Manual training schools would do for the boy in town what the farm did for his father, and more,—they would engage him in an activity which he would like, and in the prosecution of which he would have to co-ordinate his powers in the attainment of definite ends. He would be compelled to save his energies for this purpose, and not squander them in riotous living. Greek and Algebra and parsing will never keep the village boy from drink and things worse; such a curriculum is liable to drive him out of school on to the street. Everything in the schools ought to have an obvious life relation for the boy who has passed his twelfth birthday. He must feel that in mastering any study he is gaining real power, which he will find of service in the world outside."

The author provides a bibliography in which he has, unfortunately, failed to incorporate the initials of the authors cited. Finally, there are more than one hundred pages of exercises and problems. These, if used in directing and testing the observations of students, ought to prove very helpful.

The book indicates wide and careful observation. It is valuable as giving the experience and setting forth the opinions of the author. One cannot help feeling, however, that if another man of just as wide experience and just as good judgment had written the book, both experiences and opinions might have been quite different. This means, of course, that we have no science of social development, and cannot have one until our methods of studying the development of the child are refined. We cannot settle educational questions by quoting opinions, as the author, for example, does, in discussing corporal punishment. What is wanted in such cases as that, are facts and principles, not beliefs and opinions. Opinion and belief have little place in science, but since we have no science of this subject, perhaps we should not be critical of individual observation and opinion. Nevertheless, writers of books on education are too apt to set forth opinions having little support in fact, conclusions without data, broad generalizations based on casual observations. There ought to be some way of determining by strict scientific procedure the facts concerning the social development of children. Every phychologist knows how far wrong unaided observation—even of a careful observer—is likely to be.

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University of Missouri.

C. F. BIRDSEYE. *Individual Training in our Colleges.* (New York: The Macmillan Company. 1909. Pp. xxxi, 434. $1.75.)

This is a book well worth reading. It is one of the few books of which it can be said that it ought to be read by every youth contemplating college, every college student, alumnus, professor and officer. The value of the work lies chiefly in its interpretation of college life and its clear statement of problems which have been to a great extent overlooked by all concerned in college affairs.

The volume is divided into four parts. Part I., The Ecclesiastical Period of Our Colleges, gives a concrete and delightful description of the student life in the earliest colleges, together with an account of their founding, organization, purpose, and ideals. Part II., The Age of University Building, treats of the rise of universities in America, the German influence upon higher education, the great changes in number and social standing of students going to college, changes in motives, ideals, studies, entrance requirements. The question of Present College Conditions as to College and Intercollegiate Athletics fills one chapter, which discusses the undermining influence athletics are exerting upon the entire moral tone of our colleges and the insidious manner in which the plague has crept into the secondary schools: how they have introduced bribery and lying, how they have opened the way for football coaches who in some cases instruct in methods of felonious assault.

Part III., The Greek Letter Fraternities, in three chapters discusses the origin, importance, and place of the fraternity in college life. Part IV., The Remedy, attempts to solve the more important of the problems previously suggested.

The argument of the book is suggested in its title—the early small colleges produced social-problem solvers. They did this by giving to a small number of men individual training. In our great universities and colleges today the student no longer receives individual training. Professors, alumni, and endowers have forgotten the individual student in their mad rush after athletics, laboratories, and new courses of study. The student spends but a small amount of his time in the class-room—perhaps five per cent. For the remaining ninety-five per cent. he is responsible to no one. The greatest influence during these four tremendously important years is not the class-room, but the

home life of the student. This college home life is lived in dormitory, fraternity house, or boarding house. It is through these channels that the student's personal life must be reached and individual training given. The professors of the present day are specialists. Their energies are taxed to the utmost to keep abreast of the times in their own fields. They are not looking after the personal life of the students; what is more, they cannot be expected to. The alumni must shoulder this burden. How they are to do it Mr. Birdseye attempts to show.

The book as a whole is timely, clear, and well written, yet it is disappointing in certain respects. Throughout his work the author appears to identify individual training with moral and religious training, despite the fact that he is continually demanding practical efficiency as the test of such training. He constantly holds up the work of the athletic coach as almost the only remaining type of individual training. A better example would be the professor conducting a laboratory or seminary course. The author overlooks the fact that the colleges of today in their tendency toward specialization, even in the liberal arts courses, are giving a greater degree of individual training than ever before. His conviction that the early colleges gave individual training may well be called in question. Personal training they provided, but individuality was little encouraged by the narrow course, the same for all, without any consideration of special abilities, tastes, and aspirations.

In his picture of student life at the present time the author seems to have fallen victim to the "fallacy of the conspicuous." The poor and earnest student, identified in his mind with early times, is to be found by the thousands in America today—students who cook their own meals, wait on tables, rise before dawn to study in chill rooms or to deliver newspapers. The lives of such students are quiet and inconspicuous. The spendthrift and the college loafer are comparatively new factors in college life in America, but their moral code, habits, and manners cannot rightly be presented as the standards of the average student. It is true that there are colleges where students may loaf through soft "culture courses" and receive a degree if they secure a passing grade. There are others, and the number is increasing, where a student must receive the grade of "good" (next to the highest rank given) in at least half his work in order to receive his degree.

The writer's point of view is valuable because it is that of one who, though a college graduate, looks at the problems from the outside. Nevertheless, he is unable, just as President Eliot was unable, to get from under the domination of his own college. He cites (page 213) Amherst as "a good typical case" in respect to the way in which Greek Letter Fraternity houses are pushing out dormitories; whereas Amherst, as everyone knows, is an extreme case. As a fraternity man from a fraternity college, he overestimates what the fraternity can do in solving the college social problems in America, especially for that large body of men who will never enter fraternities. He is wrong in assuming, as he constantly does, that college and university faculties are not attempting to learn and solve the problems of student life.

He promised to avoid pedagogical questions, but, like every lay reformer, he sooner or later feels his ability to deal with all matters, and goes so far as to suggest that we return to the eighteenth century custom of giving students at the close of their course an oral examination on all subjects covered during the four years. He also suggests that alumni be called upon to assist the faculty in making out courses of study.

The greatest of all pedagogical problems he does not state, or at least fails to deal with: the unreality of the larger portion of the academic course of study and the wretchedly poor methods of teaching; the fact that much of the teaching in our universities and colleges would not be tolerated in a first-class high school.

In closing, it might be said that the book as a whole is weakened by repetitions, platitudes, and by sweeping statements which will not pass unchallenged by any thoughtful reader. Nevertheless, it will stimulate thought and will no doubt prove a powerful factor in compelling colleges to recognize and deal with problems which they have neglected. It is free from the wearisome philosophizing which has kept the public at large from reading many educational books. It has a message and the author is determined that this message shall strike home, and it does.

F. H. Swift.

University of Minnesota.

L. W. Cole *and* F. M. Long. *Visual Discrimination in Raccoons.* Journal of Comparative Neurology and Psychology, 19: 1909, 657-688.

J. B. Watson. *Some Experiments Bearing Upon Color Vision in Monkeys.* Journal of Comparative Neurology and Psychology, 19: 1909, 1-28.

These two papers dealing with visual discrimination in animals are interesting evidences of the present rapid advances in the use of scientific method in comparative psychology. In both cases color vision was the particular object of experimentation and both reports are portions of more extended studies.

The method which has heretofore most frequently been used in work on color vision, that of using ordinary daylight reflected from the surfaces of colored papers, was employed by Cole and Long for the study of the raccoon. Thirty-nine of the Milton Bradley colored papers and five of the Hering gray papers of equal brightness with certain groups of the colors, as determined by Rood's flicker method, were used. The papers were very carefully tested as to degree of brightness and were divided into seven groups. The papers of any one group were pasted upon ordinary drinking glasses, which were presented to the animal simultaneously in a wooden frame. The animal was to select a glass of a certain color which contained food. The position of the food glass was changed after each trial. In order to avoid the possibility that the animal might be guided by smell or any other evidence than color, many control experiments were made.

As far as the evidence from the use of this method can be accepted, the authors are undoubtedly justified in their conclusion that the raccoons can be made to discriminate objects by color alone, though they are seldom called upon to do so in their natural state. A large number of tests were required to bring it about.

As to the value of this method Watson is skeptical. In fact, in this preliminary paper on color vision in monkeys he asserts that "the use of colored papers can never give us a satisfactory test of color vision in animals." He mentions these reasons: (1) Colored papers afford numerous secondary criteria; (2) they do not reflect monochromatic bands; (3) "the range of intensity obtainable in them is so limited

that if any given region of the spectrum should offer to the animal a different order of intensity from that which the same region offers to our own eyes, the slight change which we could introduce in the brightness of a given stimulus, by substituting a paper of the same color, only lighter or darker (to our own eyes) might not at all reverse for the animal the intensity relation originally existing between the colors."

Watson has therefore devised an apparatus which makes use of spectral light. It is impossible here even to summarize a description of the apparatus, whose complexity of detail appears at first rather appalling. The principle is that of the spectrometer and the source of light was either a hand-feed arc or sunlight. By systems of lenses, mirrors and prisms the rays of light were passed through a large prism and reflected upon a screen in view of the animal; any two bands in the spectrum could be selected, sharply limited and their positions reversed at will. Three monkeys were tested and of course experiments for controlling secondary criteria were made.

These experiments were chiefly introductory and suggested as many problems as they answered. The tables show in all cases a gradual rise of discrimination until a fairly steady maximum under an unchanging set of conditions had been reached. Then the effect of introducing changes in relative brightness of the two bands and in their form and surfaces is shown. Among the interesting results noted are the following: (1) In the early part of the red-green tests the monkeys failed to react to the red. This the author considers as probably due to a preference for the green, since the habit was later acquired perfectly; (2) in the case of all the animals the blue-yellow discrimination arose more rapidly than the red-green. This might have been partly due to practice, but it again raises the question whether the whole red end of the spectrum may not have a low stimulating effect upon the eyes of animals. (3) A tendency was observed in two animals when they had partly learned to associate the food and a particular color to fall back upon choice by means of position. (4) The author points out that there is support in his tables for the conclusion that "a wave length of a given monochromatic light stimulus is, or might be, under suitable conditions, a factor in the adjustment of the animal to that stimulus." He himself refrains from drawing such conclusions at present.

There is no question but that the apparatus and method originated by Watson form a great advance in the study of color vision. They lead in the direction of that accuracy and exactness of method employed in the physical sciences. The preliminary work so far accomplished with them has suggested a large number of difficult and delicate problems which press for solution.

ADA W. YERKES.

Cambridge, Mass.

L. EDINGER. *The Relations of Comparative Anatomy to Comparative Psychology.* Journal of Comparative Neurology and Psychology, 18: 1908, 437-457.

In his interesting discussion of the relation of comparative anatomy to comparative psychology, Edinger gives some stimulating suggestions for work in both these fields. He insists that they are closely related and should be investigated simultaneously,—the anatomy of the brain and the behavior of the living animal. He describes the brain as consisting of two parts, the palæencephalon and the neëncephalon. The former is the oldest part of the central nervous system, appears in all animals from cyclostomes to man and is constant in type in all of them. The neëncephalon, on the other hand, develops above fishes and from small beginnings increases to form the largest part of the brain in man, the cerebrum.

The palæencephalon is by its structure suited to receive sense impressions from the outside world and to convey them to places whence groups of motor ganglion cells send out nerves to muscles. It includes special regulatory mechanisms among which the cerebellum is the most important. Not only all activities which are commonly designated as reflex, but also all instincts, the author asserts, are localized in the palæencephalon. No part of it can be absent without a corresponding function becoming lost, and all parts develop in size according to the demands which the activities of the animal make upon them. A knowledge of the degree of development is of the highest importance for sense psychology and will always give information as to the possible activities of the animal.

Fishes possess only the palæencephalon and it is therefore important that their activities should be thoroughly studied. They are able to establish simple new relations between sense impressions and movement

combinations, but not to form associations or to construct memory images out of several components. Among the reptiles, however, where the neëncephalon makes its appearance, the author states that "the animals are no longer always dependent on the sense impression of the moment, but that earlier impressions influence them. Further, they associate certain sense impressions which lie within the realm of the olfactory and oral senses, and turn them to account; they learn more readily than the fishes and amphibians; occasionally they foresee; and they exhibit individual differences. There can be no doubt that all of these facts are referable to the appearance of a cortex in the neëncephalon." In the birds the palæencephalon is enlarged and reaches a high state of perfection, but the cortex is also more highly developed than in reptiles. The inference from this structure that the instinctive actions must be of much greater variety and perfection, and also the capacity for forming associations must be much greater than in reptiles seems to be justified in the author's opinion, so far as trustworthy studies of behavior have gone. Further observation of birds and reptiles must determine "what activities of the lower vertebrates are palæncephalic and what are neëncephalic" and whether neëncephalic reflexes and instincts exist.

The author refers only briefly to the tasks of the anatomist in connection with mammalian psychology. In spite of extensive studies recently of the mammalian cortex he asserts that we know "surprisingly little as soon as one enquires how much our knowledge tells us about the functions." He urges that anatomical study and psychological observation be united first in the simpler field among those animals which possess only a very simple neëncephalon.

The objection might be made that what the author has described as the field of comparative psychology is really rather that of physiology. He does, it is true, rather sharply separate the simple activities and the instincts of animals from other psychic phenomena, but he states that this is a question of method chiefly. By associating them with the palæencephalon alone, he establishes a foundation upon which to build the comparison between degree of development of various parts of the entire brain and the possession of psychic qualities.

ADA W. YERKES.

Cambridge, Mass.

D. SNEDDEN. *Educational Tendencies in America.* Educational Review, 39: No. 1, January, 1910. Pp. 13-31.

Dr. Snedden notes the following tendencies as significant of the present trend of American education:

(1) The need for vocational instruction is being felt more keenly than ever before, and this feeling finds expression in the present rapid development of vocational courses; this increasing emphasis is gradually leading to a more effective recognition of "concrete realities, rather than abstractions" as the basis of educational endeavor; at the same time it is significant that vocational education is not being, and does not promise to be, divorced from the training that makes for culture and for social and civic efficiency.

(2) There is an endeavor "to find a definition of integral education, and to take steps to realize it." Dr. Snedden means by an integral education, one which takes cognizance of the various educational forces that operate in the training of the child; and the problem of those who are attempting to define such an education is to fix definitely the responsibility that each of these forces—the home, the school, the church, and the workshop—must assume.

(3) There is a noteworthy tendency to evolve a system of educational method. This tendency is revealed most clearly and has produced the best results in the work of the lower grades. In the work of the upper grades and the high school, which is still far from satisfactory, there is "a hopeful attitude of study, of experimentation, of modification, and of progress."

W. C. B.

CYRIL BURT. *Experimental Tests of General Intelligence.* British Journal of Psychology, 3: December, 1909, 94-177.

"Parental intelligence, therefore, may be inherited, individual intelligence measured, and general intelligence analyzed; and they may be analyzed, measured, and inherited to a degree which few psychologists have hitherto legitimately ventured to maintain." This is the concluding paragraph of Mr. Burt's 80-page article.

The author hoped by this study to throw some light on three main inquiries: (1) Can the presence of general intelligence be detected and its amount measured? (2) "Can its nature be isolated and the mean-

ing analyzed?" (3) Is its development predominantly determined by environmental influence and individual acquisition, or is it rather dependent upon the inheritance of a racial character or family trait?

The Tests.	*Nature of Process Tested.*
I. Sensory Tests.	
(1) discrimination of two points upon the skin (2) discrimination of lifted weights (3) discrimination of pitch (Spearman dichord) (4) comparison of length of lines by eye	Perceptual discrimination.
II. Motor Tests.	
(5) tapping (puncturing paper at maximum speed with mounted needle). (6) card-dealing (after Jastrow).	Simple reactions.
III. Sensory Motor Tests.	
(7) card-sorting (cards from different packs sorted according to color on backs)	Reaction complicated by discrimination.
(8) alphabet-finding (from two complete alphabets laid out haphazard subject arranges one in order)	Reaction complicated by recognition.
IV. Association Tests.	
(9) immediate retention of (a) concrete words (b) abstract words (c) nonsense syllables	Immediate memory.
(10) mirror test (subject traces geometrical figure, watching his hand in the mirror)	Formation of association during motor activity. "Trial and Error."
(11) spot-pattern test (arrangement of from 7 to 9 spots exposed for 1-25 second, to reproduce position of spots)	Formation of associations during perceptual activity. (Progressive process of "Apperception.")
V. Test of Voluntary Attention.	
(12) dotting irregular dots (as they appear in aperture 5x10 cm. in lid of desk)	Maximal effort of sustained attention.

The author considers the Alphabet, Mirror, Spot and Dotting tests new in this connection.

A group of boys, ranging in age from 12 years 6 months to 13 years 6 months, were selected from two Oxford schools—"a superior elementary school and a high-class preparatory school"—to serve as observers. The thirty boys from the elementary school were from "the lower middle class, sons of local tradesmen." The thirteen from the preparatory school "were in nearly every case sons of men of eminence in the intellectual world." The tests were also given to a "congenital imbecile."

Simple sorts of apparatus were used that the element of distraction be reduced to the minimum. Observers were tested individually, and in the case of some tests several sittings were required.

The intelligence of the observers was estimated provisionally by the headmaster of each school, who based his judgment upon personal acquaintance and estimates from boys not in the tests, as well as upon class grades.

The method used in calculating correlations was similar to the "foot-rule" or R method of Spearman.

It is impossible for the reviewer to do justice to the large amount of data presented in four full-page tables. Suffice it to give briefly the most general results and conclusions. The results indicate that the six simple sensory and motor tests are of but little use in the empireal diagnosis of intelligence. On the other hand, if we arrange the boys according to the results of the other tests, "we obtain a list correlating with the headmaster's order to the extent of .85 at the elementary schools and .91 at the preparatory school.

"By means, then, of some half-dozen tests, we are able independently to arrange a group of boys in an order of intelligence, which shall be decidedly more accurate than the order given by scholastic examinations, and probably more accurate than the order given by the master, based on personal intercourse during the two or three years and formulated with unusual labor, conscientiousness and care."

In reference to the analysis of intelligence, the author concludes: "High intelligence seems to mean high capacity for continually systematizing mental behavior by forming new psycho-physical co-ordinations, older co-ordinations being retained, so that newer co-ordinations bring with them increasing complexity and incessant change. In such progressively integrative actions of the mind the effective and directive agent is attentive consciousness."

Regarding the third inquiry, which relates to the inheritance of intelligence, it must be noted that the average performance of the boys of the preparatory school was, excepting in weight and tactual space discrimination, superior to that of the boys of the elementary school. Mr. Burt claims that this was not due to superior training or environment, but to the superior parentage of the boys in the preparatory school.

The study is a very valuable one, but we need many more equally thorough along the same line.

WALTER R. MILES.

University of Iowa.

The Prussian minister of education has addressed a circular to the universities recommending the organization of courses of instruction in open air games. Emphasis is laid on German national games, and the purpose of the movement is to train instructors for primary and secondary schools.

We learn from the *Zeitschrift für Experimentelle Pädagogik* that the German Teachers' Association has recently established a "pedagogical center" in Berlin, one of the functions of which will be the publication of a *Jahrbuch*. One section of this, entitled "Child Psychology and Pedagogy," will be edited by Dr. M. Brahn, Director of the Leipzig Institute for Child Psychology. Another section, "Problems of Elementary Education," will be divided into a number of sub-sections under the editorship of distinguished educators.

NOTES AND NEWS.

We take pleasure in calling the attention of our readers to *"School Hygiene,"* an English monthly devoted to the interests of health in the schools, the first number of which appeared in January, 1910. The first five numbers contain interesting articles on medical inspection, school clinics, mental fatigue, tests of intelligence, etc. The publication office is located at 2 Charlotte St., London, W., and the subscription price for the annual volume of about 700 pages is 7s. 6d.

During the week of May 12-19 a Mouth Hygiene Exhibition was held in New York City under the auspices of the New York Dental Hygiene Council. One of the conferences was devoted to the consideration of dental hygiene in education, and arguments were advanced for the establishment of school dental clinics.

The children's court at Charlottenburg, Berlin, has just finished its first year. In this time 232 children have been brought before it, and 196 cases have come to trial. In general the efforts of the court have received the support of parents and guardians, but in some cases parents have resented and protested against the probationary measures adopted.

A professor in Berne University, according to the Albany *Citizen,* has traced the history of a family which may well be compared with the history of the Jukes family. In the end of the eighteenth century, a woman died, who for forty years had been "a thief, a drunkard, a tramp." The investigator has found 834 descendants from this woman, and 707 he has succeeded in tracing from youth to old age. Of these, 106 were born out of wedlock, 142 were beggars, and 64 more lived on charity. Among the women, 181 lived loose lives, and in the family have been 76 convicts and 7 murderers. He estimates that in 75 years, this family has cost the German authorities in almshouses, law courts, prisons, and other institutions, about $1,250,000. What the cost was in spiritual loss and loss in social efficiency is not stated, and it is doubtful if it can be measured.

We have already noted in these columns the meeting at Paris, December 27, 1909, of the Committee of the International Congress of Paidology. On the same date and at the same city there was held a meeting of the International Committee of Educational Psychology. These two organizations profess aims which are closely similar—the organization of national and of international congresses, the co-ordination and centralization of work, etc.—save that the latter committee has emphasized the aim of applying in educational practice the positive results of research in educational psychology.

Without going into details (for which the reader may consult the January issue of the *Archives de psychologie*), it seems evident, at least so far as one can judge at this distance, that the advancement of educational research would be best served by a fusion of these two independent, and at present somewhat conflicting lines of activity.

The second of the committees named above was organized provisionally by Binet in 1905, but had been inactive until the meeting was held in December, 1909. It is represented in France by Binet and Bédorez, in Germany by Ufer and Meumann, in England by Rivers, in Belgium by van Biervliet, in Holland by Heymans, in Italy by de Sanctis, in Russia by Sikorski, in Switzerland by Claparède; the vacancy caused by the resignation of Professor Baldwin, who at first represented America, has been filled by the selection of Professor Whipple, of Cornell University.

Among the plans recently announced by the authorities of Johns Hopkins University for the extension of the work of the institution is the establishment of a training school for teachers.

During the week of May 1-7 the Brooklyn Training School for Teachers celebrated the twenty-fifth anniversary of its foundation. In this period the school has had a phenomenal growth from a mere handful of students to an enrollment of nearly 1200. The celebration included a memorial service for those teachers who have died in active service, a field day, an exhibition of the work of the school, a parents' evening, an allegorical program representing social progress in the past twenty-five years, and ended with an alumni reunion.

Dr. Stevenson Smith, professor of psychology in Hampden-Sidney College, will conduct a psychological clinic for backward children this summer at Teachers College, Columbia University.

The National Association for the Study and Education of Exceptional Children held its annual meeting in New York City, April 21 and 22. Among the papers presented were, "What is being done in the Public Schools of New York City in the Training of Exceptional Children?" by Associate City Superintendent Andrew W. Edson; "The Exceptionally Bright Child," by Maximilian P. E. Groszmann, and "The Training of Teachers for Backward and Exceptional Children," by Will S. Monroe.

At Harvard University Professor E. B. Holt announces a course of lectures for next winter on the history of psychological problems.

Professor James R. Angell, of the University of Chicago, has gone to Europe, to remain until September. Professor Walter F. Dearborn, of the same institution, is also in Europe.

Dr. Henry H. Goddard, Director of the Department of Psychological Research, New Jersey Training School for Feeble-Minded Boys and Girls, sails for Europe on the 9th of July. Dr. Goddard expects to attend the International Congress of School Hygiene at Paris and the Brussels Conference on Home Education, at each of which he will present a paper. Dr. J. E. Wallace Wallin, of the Cleveland Normal Training School, will take charge of Dr. Goddard's work in psychology at the Summer Session of the New Jersey Training School.

So great has been the interest manifested in the Summer School Course of the New Jersey Training School for Feeble-Minded Boys and Girls, and so many more people have applied for admission than could be accommodated, that Superintendent Johnstone has decided to open a winter course in February, March and April.

Dr. Bird T. Baldwin, professor of psychology and education at West Chester State Normal School and Swarthmore College, recently lecturer in the School of Education, Chicago University, has been appointed professor of school administration in the University of Pittsburg.

W. S. Ellis, principal of King's Collegiate Institute, has been appointed dean of the faculty of education in Queen's College, Kingston, Ontario. Sinclair Laird, of Dundee, Scotland, has been made associate professor of education at the same institution.

At Yale University, Dr. E. H. Cameron has been advanced from an instructorship to an assistant professorship in psychology.

Mr. H. F. Adams, Fellow in the University of Chicago, has been appointed instructor in psychology in the University of Kansas.

Dr. R. M. Ogden, of the University of Tennessee, has been advanced to a professorship of philosophy and psychology.

Professor George P. Bristol, of the department of Greek, and director of the summer session, Cornell University, has been appointed head of the School of Education in that institution.

Dr. W. Van Dyke Bingham, instructor in educational psychology, Teachers College, Columbia University, has been appointed assistant professor of psychology in Dartmouth College.

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C. B. Davenport. *Eugenics: The Science of Human Improvement by Better Breeding.* New York: Henry Holt & Co., 1910. Pp. 35. 50c.

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F. Watson. *The Beginnings of the Teaching of Modern Subjects in England.* London: Sir Isaac Pitman's Sons, Ltd., 1909. Pp. lvi, 555. 7s. 6d.

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